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22-11-55

PURDUE UNIVERSITY

Bulletin

17382
22/XI/55
Series
22 NOV. 1955

SCHOOLS OF ENGINEERING

Announcements 1955-56

UNIVERSITY CALENDAR

1955

SEPTEMBER

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First Semester

June 13-August 6
Advance registration for new undergraduate students

September 14-17
Placement tests

September 18-21
Orientation for all new students

September 22
Classes begin

November 23, 6 p.m.
Thanksgiving vacation begins

November 28, 7 a.m.
Classes resume

December 21, 6 p.m.
Christmas vacation begins

January 5, 7 a.m.
Classes resume

January 28, noon
Classes end

Second Semester

January 30-February 1
Orientation and registration of new students

February 2
Classes begin

March 28, 6 p.m.
Easter vacation begins

April 5, 7 a.m.
Classes resume

May 30, 6 p.m.
Classes end

June 3
Commencement

Summer Session

June 8-9
Registration of new students

June 11
Classes begin

July 4
Independence Day Holiday

August 4, noon
Classes end

PURDUE UNIVERSITY BULLETIN
VOL. LV
February 1, 1955
No. 11
Entered at Lafayette, Indiana, as second-class matter, under Act of Congress of August 24, 1912. Issued at Purdue University four times in January, five times in February, three times in March, twice in April, and once in May, June, July, August, September, October, November and December.

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Board Hut

SCHOOLS OF ENGINEERING

Announcements for the Year 1955-56

PURDUE UNIVERSITY

Eighty-first Year

LAFAYETTE, INDIANA

PUBLISHED BY THE UNIVERSITY

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OFFICERS OF ADMINISTRATION AND INSTRUCTION

ADMINISTRATIVE OFFICERS

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Frank C Hockema, M.S.M.E., Ed.D.	Vice President and Executive Dean
Robert Bruce Stewart, A.M., LL.D.	Vice President and Treasurer
Lytle Justin Freehafer, A.B.	Business Manager

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George Andrew Hawkins, Ph.D.	Dean of the Schools of Engineering; Director of the Engineering Experiment Station
Willard Alfred Knapp, B.S.C.E., C.E.	Associate Dean of the Schools of Engineering; Head of the Curriculum of Engineering-Law.
Paul Franklin Chenea, Ph.D.	Assistant Dean of the Schools of Engineering, Head of the Division of Engineering Sciences, Acting Head of the Department of General Engineering
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Helen Blanche Schleman, M.S.	Dean of Women
Ernest Charles Young, Ph.D.	Dean of the Graduate School

HEADS OF INSTRUCTIONAL DEPARTMENTS

George Everett Spencer, M.S.E.	Acting Head of the Department of Agricultural Engineering
*Milton Ure Clauser, Ph.D.	Head of the School of Aeronautics
Harold Miller DeGroff, Jr., Ph.D.	Acting Head of the School of Aeronautics
Edward Walter Comings, Sc.D.	Head of the School of Chemical and Metallurgical Engineering
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Albert Ruff Spalding, Ph.D.	Head of the Department of Freshman Engineering
Kenneth Brady Woods, B.C.E., C.E.	Head of the School of Civil Engineering

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* Leave of absence 1954-55.

ENGINEERING AT PURDUE

ENGINEERING INSTRUCTION has been offered at Purdue University since the institution first opened its doors to students. As a land grant college Purdue was founded primarily to teach the agricultural and mechanical arts. Since the mid-1920s, Purdue University School of Engineering has been the largest in the United States in terms of resident day undergraduate enrollment.

One student was registered in Civil Engineering in the fall of 1876 and the first engineering degree (C.E.) was awarded in June, 1878. The School of Mechanics, established in 1879, led to the founding of the School of Mechanical Engineering in September, 1882. Although civil engineering was the first branch of technical instruction to be taught at the University, it was not until 1877 that the School of Civil Engineering was organized. Electrical Engineering was organized as a separate school in 1888.

Chemical Engineering was established as a course of study in 1906 and made a separate school in 1911. Metallurgical Engineering was added to the degree offerings of this School in 1938 and the name was changed to the School of Chemical and Metallurgical Engineering.

Special curricula in Public Service Engineering (discontinued in 1948) and Engineering Law were offered for the first time in the fall of 1935.

Aeronautical Engineering courses were offered as options in Mechanical Engineering for the first time in 1926. The four years of Aeronautical Engineering as an offering of the School of Mechanical and Aeronautical Engineering appeared initially in the announcements for the sessions of 1942-43. Twenty-three students received the first degrees in aeronautics in August, 1943. The School of Aeronautics, which includes the curricula of aeronautical engineering and air transportation with separate staff and facilities, was set up as a school in July, 1945.

In July, 1944, the Department of Engineering Mechanics was merged with the School of Civil Engineering and the name changed to the School of Civil Engineering and Engineering Mechanics, awarding separate degrees in civil engineering and engineering mechanics. In July 1954 the Department of Engineering Mechanics was set up as a separate division and the name changed to Engineering Sciences.

Agricultural Engineering offered jointly by the School of Agriculture and the Schools of Engineering was begun in September, 1946.

ENGINEERING INSTRUCTION

UNDERGRADUATE instruction in Aeronautical Engineering, Air Transportation, Agricultural Engineering, Chemical Engineering, Metallurgical Engineering, Civil Engineering, Engineering Mechanics, Electrical Engineering, and Mechanical Engineering, leads to the degree of Bachelor of Science.

A special curriculum in engineering-law gives an engineering foundation for the study of law.

Well-prepared students can usually complete the plan of study leading to the degree of Bachelor of Science in any of the engineering curricula in four years. Many students, however, may find it advantageous to devote more than four years to the undergraduate engineering programs of study by pursuing at one time, in any semester, fewer studies than are regularly prescribed. In cases of inadequate secondary preparation, poor health, or financial necessity requiring much time for outside work, the undergraduate course should be extended to five years or longer. A student who so desires may devote five years to his undergraduate work and include additional instruction in the humanities, the social sciences, the physical sciences, or mathematics.

A student enrolled in engineering must have earned a cumulative scholarship index of at least 3.35 at the end of his second and fourth semester in order to continue in any of the engineering schools.

Advanced courses and research problems leading to the degrees of Master of Science or Doctor of Philosophy may be elected in the various special fields of engineering by those who have completed a standard four-year engineering college curriculum. Graduation in the upper third of their class is required for admission to the graduate programs of the Engineering Schools. Details concerning graduate study in engineering will be found in a special bulletin on graduate study.

Nuclear Engineering. Advanced courses and research problems in the field of nuclear engineering may be included in a graduate student's plan of study in each of the schools of engineering. Students electing a major in nuclear engineering for their plan of study for the master's or Ph.D. degree will receive a Master of Science, a Master of Science in Engineering or a Ph.D. degree, regardless of the particular school of specialization. Minors may be included in the usual manner in the plan of study for any graduate degree. Undergraduates may elect courses in nuclear engineering with the approval of their counselor.

Business Training for Engineering Students. Students at Purdue University in the major engineering curricula who intend, upon graduation from Purdue, to supplement their engineering preparation with basic instruction in business by becoming candidates for a master's degree in business administration at Indiana University, should include in their undergraduate curricula the following subjects: economics, 6 hours; accounting, 3 hours (6 hours recommended); industrial management, 3 hours; also some background in courses such as statistics, money and banking, corporation finance, marketing, and business law. Students may ordinarily expect to devote two semesters plus one summer session (minimum) to four semesters (maximum) to complete the requirements for a master's degree in business administration at Indiana University, depending upon the number of pre-business courses completed at the time of the transfer. Students must have an index of 4.5 or better earned at Purdue University to be admitted to the School of Business at Indiana University under the above plan.

ADMISSION

REQUIREMENTS FOR ADMISSION—FRESHMEN

For admission to the freshman class an applicant must present credits in 15 units of secondary school work.

For all applicants to the Schools of Engineering the prescribed fifteen units of credit must be distributed as follows:

English	3 units
History or Social Studies	1 unit
Algebra	1½ units
Plane Geometry	1 unit
Solid Geometry	½ unit
Laboratory Science	1 unit
Additional English, language, mathematics, science, or social studies	3 units
Other high school subjects	4 units
	15 units

German is recommended for those who expect to study chemical or metallurgical engineering.

An applicant for admission to engineering who is deficient only in solid geometry but has credit for two units of algebra or a half unit of trigonometry will be admitted but required to make up the solid geometry during his first year. Similarly, one who has credit for only one year of algebra but has credit for solid geometry and one-half unit of trigonometry will be admitted with a deficiency of one-half unit in algebra, which will be considered satisfied when he has passed Mathematics 131 or 141.

It is urged that the applicant for admission to engineering present credit for trigonometry and for a fourth semester of algebra for a total of two units of algebra. It is further urged that the fifteen units submitted for admission include two units of natural science with laboratory work, preferably physics and chemistry.

PROCEDURE FOR MAKING APPLICATION

An application for admission must be made on a form obtainable from the Director of Admissions. Complete information on admission to the University is given in the *General Information Bulletin.*

ADVANCED CREDIT

Credit for courses in Purdue University will be given on account of work of equivalent character and amount successfully done in another college. On the basis of these credits, advanced standing will be determined. Advanced credit will be regarded as provisional and may be withdrawn by the Director of Admissions upon recommendation of the head of the department concerned or if dependent work is not satisfactorily completed.

When credit earned at another college or university is transferred to Purdue University and is accepted toward advanced standing, the credit is converted into terms of Purdue courses and applied on the program of study. Credit will not be allowed for a course in which the lowest passing grade was received. Grades are not transferred; only credit in the course is recorded.

For credit in shop work and engineering drawing based on work done in industry or elsewhere than in an educational institution of recognized standing, the applicant must submit letters of qualification from his employers and samples of his drawings and may be required to pass an examination.

ADMISSION TO THE ENGINEERING SCHOOLS OF GRADUATES OF LIBERAL ARTS COLLEGES

Properly qualified holders of the degree of Bachelor of Arts or Bachelor of Science from recognized four-year liberal arts colleges should be able to complete the requirements for the degree of Bachelor of Science in most of the Schools and curricula of engineering at Purdue University in about two years including summer session. They must submit, in addition to the entrance requirements in force at Purdue for the Schools of Engineering, the following college credits:

Mathematics, 18 semester hours (college algebra, trigonometry, and analytical geometry, 10 hours; calculus, 8 hours); physics, 10 hours; chemistry, 8 hours.

Such college graduates may usually be registered as junior students in engineering. These students are allowed to substitute credits earned in subjects not listed in the engineering curriculum for military training, freshman engineering lectures and non-technical subjects, and for such other subjects as the Dean of the Schools of Engineering may approve. They will find it to their advantage to make up at least in part during the summer session previous to entrance such subjects as drawing, shop laboratory practice, or other required technical subjects of the first two years.

ADMISSION OF SPECIAL STUDENTS

Mature persons who desire to avail themselves of the instruction offered in any of the departments of the University without undertaking one of the regular plans of study and without becoming candidates for degrees may be admitted as special students. Such students must present satisfactory evidence that they are prepared to take advantageously the work desired.

Application for admission as a special student should be made on a prescribed form to be obtained from the Director of Admissions and should be approved by the dean or head of the school in which the student expects to register.

COOPERATIVE PROGRAMS WITH LIBERAL ARTS COLLEGE

Cooperative programs are being set up with accredited liberal arts colleges which will permit their students to transfer to the Purdue University campus at the end of the junior year. Students interested in engineering should ordinarily be able to complete the requirements for an engineering degree in two years and one or two summer sessions provided they have the mathematics, physics, and chemistry credits scheduled in the freshman and sophomore years for engineering students.

It is expected that these cooperating colleges will give the student a bachelor's degree either at the end of the student's first year at Purdue University or at the time Purdue awards the engineering degree.

Students planning to transfer from liberal arts colleges to Purdue should contact the Dean of Engineering early in their courses in order to obtain assistance in planning their programs of study.

TRANSFERS FROM JUNIOR COLLEGES

Purdue University will accept transfer students from accredited junior colleges to most of the curricula of engineering if these students meet the entrance requirements in engineering as outlined on p. 7 and have an honorable dismissal from the junior college. Credits in all subjects which apply to the engineering curricula will be accepted providing the grade received in the subjects are better than the lowest passing grades (C or better) and if the land grant college or state university in the state in which the junior college is located will accept the credits.

A transfer student who has credits in mathematics 18 semester hours (college algebra, trigonometry, and analytical geometry, 10 semester hours; calculus 8 semester hours); physics 10 semester hours and chemistry 8 semester hours should be able to complete the requirements for the engineering degree in about two years plus one or two summer sessions.

Students planning to transfer from a junior college to Purdue University should contact the Dean of Engineering early in their courses in order to obtain assistance in planning their programs of study.

COOPERATIVE PROGRAMS WITH INDUSTRY

The School of Mechanical Engineering offers a five-year cooperative education program which enables a limited number of qualified students to obtain industrial experience with selected industries while completing the requirements for an engineering degree. Upon completion of the program, the students receive the regular degree of Bachelor of Science in Mechanical Engineering and a certificate indicating their completion of the cooperative education program with industry. Further details of the program are set forth in the description under Mechanical Engineering. Plans are now being developed which will enable students enrolled in other Purdue engineering schools to participate in the cooperative programs with industry.

TIME OF ENTRANCE

A new student may begin his program of study with any regularly scheduled registration, which usually takes place three times a year—in September, January, and June. Consult the University calendar for definite dates. With the exception of a short vacation period in August, the normal calendar will provide for continuous attendance for those who wish to complete a program of study in the shortest possible time. The time required will be governed by the curriculum in which the student is enrolled.

All students in engineering are required to take an orientation test in mathematics. All students in engineering who are admitted with high school credits in Trigonometry are offered a second orientation test in this subject. These two orientation tests will serve as a placement test in mathematics for engineering students who do not present advanced credits in mathematics. Students planning to major in mathematics, physics, or chemistry are urged to take both tests. Other students may take both tests.

On the basis of the entrance units and the placement test, students will be divided into three groups, and assigned to mathematics courses as follows: (a) The upper group, namely students who make above a certain total score on the two tests, will be assigned to the second-semester course (Math. 142, Analytic Geometry). These students will be given credit for the first-semester course. (b) The middle group will be assigned to the regular first-semester course (Math. 141, College Algebra and Trigonometry) meeting five times a week. (c) The lower group, those students who make below a certain score on the first orientation test, will be assigned to (Math. 131, Elementary Engineering Mathematics) a course meeting six times a week for five hours of credit. This assignment will continue for two semesters, and the instruction will include a rapid review of high school algebra in addition to topics covered in the regular freshman courses in mathematics.

EXPENSES

See the *General Information Bulletin* for fees and tuition and other general information not included in this bulletin.

RESEARCH AND EXTENSION

In addition to the schools and departments of instruction, the Schools of Engineering maintain or cooperate with other engineering services of value to the public through research and extension.

I. *The Engineering Experiment Station,* whose organization was approved by the Board of Trustees in 1917, conducts researches in the various fields of engineering, cooperates with engineering societies, industries, railroads, utilities, public works, and the government, and publishes in bulletin form, in papers before engineering groups, and in the engineering press, the results of its investigations.

Most of the investigations carried on in the Engineering Experiment Station are supported by industries, utilities, and the government and have included major contributions in the fields of transportation (railway, highway and air transport), heat transfer, electric power transmission, materials, gas technology, electronics, and power engineering.

II. *A Division of Technical Extension,* operating as a separate division of the University but cooperating closely with the Schools of Engineering, was established by the Board of Trustees in 1945, to coordinate all extension activities of the University except those carried on by the agricultural extension service. Extension instruction, under the direction of the subject-matter departments, is conducted through this division, and includes off-campus classes, both credit and non-credit, correspondence study, short courses, conferences, clinics, lectures, demonstrations, publications, and other formal and informal enterprises conducted off the campus.

Extension activities of the Schools of Engineering are carried on through the Division of Technical Extension.

III. *The Division of Technical Institutes* is administered by the Division of Technical Extension in cooperation with the engineering and other schools of the University. The Technical Institute programs are offered on and off-campus and furnish specialized, intensive study designed to meet the needs of industry for technically trained persons. These programs are self-contained and lead to Technical Institute Diplomas. Training is offered in five major fields of study: I. Drafting and Mechanical Technology, II. Electrical Technology, III. Industrial Technology, IV. Chemical and Metallurgical Technology, V. Building Construction Technology.

IV. *The Purdue Research Foundation* was incorporated under the laws of the State of Indiana in 1930. This act provides a legal device which makes it possible for Purdue University to undertake activities of fundamental importance not clearly within the province of the trustees of the University as defined by federal and state laws.

The Engineering Experiment Station cooperates with the Purdue Research Foundation in research involving patents, etc.

ENGINEERING ORGANIZATIONS

Technical Societies. Associated with the various schools and departments of technical instruction are student branches of the major national technical or scientific societies including American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Agricultural Engineers, American Society of Civil Engineers, American Society of Heating and Ventilating Engineers, Society of American Military Engineers, American Society of Mechanical Engineers, American Society of Tool Engineers, Institute of Aeronautical Sciences, Institute of Radio Engineers, National Defense Transportation Association, Society for Advancement of Management, Society of Automotive Engineers.

Other technical and semi-technical organizations of special interest to engineering students include Aeroliner, Amateur Radio Club, Catalyst Club, Model Railroad Club, Purdue Aero Club, Aeromodelers, Glider Club, Radio Club, and Student Engineering Council.

Honorary Fraternities are designed to recognize students who excel in scholarship and give promise of being leaders in professional areas. Honorary fraternities are branches of national societies and with one exception are open to juniors and seniors only.

The following honorary fraternities have chapters at Purdue University:

- Chi Epsilon (Civil Engineering)
- Eta Kappa Nu (Electrical Engineering)
- Omega Chi Epsilon (Chemical Engineering)
- Phi Eta Sigma (Freshman and Sophomore Engineering)
- Pi Omicron (Women Engineers)
- Pi Tau Sigma (Mechanical Engineering)
- Sigma Alpha Tau (Air Transportation)
- Sigma Gamma Epsilon (Metallurgical Engineering)
- Sigma Gamma Tau (Aeronautical Engineering)
- Sigma Xi (Scientific—all schools)
- Tau Beta Pi (All Engineering)

THE GOSS LIBRARY

THE WILLIAM FREEMAN MYRICK Goss Library of the history of engineering or briefly, the Goss Library, was established in 1928 when Purdue University received the personal library, consisting of approximately 900 volumes, from Dr. Goss, Dean of Engineering at Purdue University from 1879 to 1907. Two years later Mrs. Edna D. Goss, his widow, presented to the University a trust fund of $20,000 as an endowment for the library. The library now contains over 5000 volumes and is considered the most complete library of engineering history available in any university. This library is housed in the Engineering Administration Building.

MILITARY TRAINING

PURDUE UNIVERSITY, being a land grant college, requires all able bodied male students to take two years of military training (Basic Course). Advanced Military Training (Advanced Course) offered during the last two years is optional. Basic and Advanced ROTC programs in Army, Navy and Air Force are offered at Purdue University. Band may be used as a substitute for both basic and advanced military training.

Students enrolled in Army ROTC elect Chemical Corps, Corps of Engineers, Ordnance Corps, Signal Corps, Transportation Corps or Artillery at the beginning of their third semester. Recommended units for the several engineering schools are as follows: Chemical Corps (Chemical and Metallurgical Engineers), Corps of Engineers (Civil Engineers), Ordnance Corps (Mechanical and Metallurgical Engineers), Signal Corps (Electrical Engineers and Amateur Radio Operators), Artillery (any school) and Transportation Corps (any school).

Students accepted for Naval ROTC (open to students in any curricula, except Pharmacy, which leads to a baccalaureate degree with four years residence on the campus) either as regular or contract students must carry this program for four years. The first two years satisfy the military training requirements of the University and the last two years as advanced military training.

Students enrolled in the Air Force ROTC receive a non-specialized course covering the fundamentals of Air Force operation. The Basic course (freshman and sophomore) gives the student a general understanding of the Air Force and its place in national defense. The Advanced Course (junior and senior) covers the detailed operations of the Air Force including strategy and related subjects useful in the training of future Air Force officers.

Students accepted for Advanced Military (Army, Navy and Air Force) may use Advanced ROTC credits earned for 12 credit hours of non-technical and technical elective or required courses as approved by the head of their school. The practice varies between the several schools but in general the distribution provides for 6 credit hours of non-technical and 6 credit hours of technical courses.

See *General Information Bulletin* for more detailed information concerning the ROTC programs of the Army, Navy and Air Force.

FRESHMAN ENGINEERING

THE DEPARTMENT of Freshman Engineering offers a program of study during the first year which is common for the degree-granting curricula in aeronautical engineering, air transportation, agricultural engineering, chemical engineering, civil engineering, engineering mechanics, electrical engineering, mechanical engineering, metallurgical engineering, and engineering-law. This common program gives the student time to adjust himself and to choose the branch of engineering for which he is best adapted. Lectures and individual counseling are provided the student so that by the end of the first semester he may make a tentative selection of a school or curriculum which becomes effective at the beginning of the Sophomore year.

First Semester

(4) Chem. 101 or 117 (General Chemistry)
(3) Engl. 101 or 103 (Composition)
(2) G.E. 121 (Engineering Drawing)
(0) G.E. 100 (Engineering Lectures)
(5) Math. 141 (Algebra, Trigonometry) or Math. 131 (Elementary Engineering Mathematics)
(⅔) *P.E.M. 100 (Personal Living)
(2) G.E. 151 (Welding, Heat Treating and Casting) or C.E. 100 (Plane Surveying)
(2 to 3) *Military Training

(18⅔ to 19)

Second Semester

(4) Chem. 102 or 118 (General Chemistry)
(3) Engl. 233 (Essay), Engl. 235 (Drama), Engl. 237 (Poetry), or Engl. 238 (Fiction), Engl. 250 (Amer. Books), or †Spch. 114 (Principles of Speech)
(2) G.E. 122 (Engineering Drawing)
(5) Math. 142 (Analytic Geomerty) or Math. 132 (Elementary Engineering Mathematics)
(2) C.E. 100 (Plane Surveying) or G.E. 151 (Welding, Heat Treating and Casting)
(2⅓ to 3) *Military Training

(18⅓ to 19)

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* Military Training and Physical Education. All male students not excused for physical disability or other causes are required to take Military Training (Basic) throughout the freshman and sophomore years. This requirement may be satisfied either in the Army, Navy, or Air Force ROTC or in the Military Band. The term "military training" in each of the plans of study covers all these possibilities. Students in the Naval ROTC are exempt from Personal Living (P.E.M. 100). Veterans with one year of military service are exempt from Basic Military Training and P.E.M. 100 (without substitute); others excused from Military Training are required to substitute other subjects of equal weight.

† Spch. 114 is required of all engineering students either in the freshman year or later.

AERONAUTICS

The School of Aeronautics offers instruction leading to degrees in Aeronautical Engineering and Air Transportation. It is located at the Purdue University Airport, approximately one mile from the main campus. Special bus service between the campus and the Airport is provided on a regular schedule without cost to the student.

Aeronautical Engineering Laboratories

Principal laboratories of the School of Aeronautics are as follows: In the **Aerodynamics Laboratory** three wind tunnels are available for studies in Aerodynamics: (1) A small single pass tunnel for studying pressure distributions around airfoils. (2) A variable density tunnel with a 15 inch throat capable of speeds up to 300 mph at pressures varying from one third to three atmospheres. (3) A 350 mph tunnel having a test section of 11½ sq. ft. with an exceptionally low turbulence factor. A shock tube for study and research in high speed flow has been built recently. A water table is available for demonstrating compressible and viscous flows.

The **Aircraft Powerplant Laboratory** is provided with several types of equipment available for instruction and research, including two single cylinder test engines. One of these has an electronically controlled dynamometer and instrumentation for automatically controlling manifold pressure, humidity, and coolant temperature as well as a cathode ray oscilloscope for showing pressures developed in the engine. The other is especially designed for fuel testing and rating according to octane numbers. An aircraft engine test unit is used for instructional studies on a full scale engine. A small turbo-jet engine mounted in a special test cell provides opportunity for studies of this type of powerplant. Turbo-jet engine components are studied in two installations especially designed for this purpose.

The **Aircraft Structures and Dynamics Laboratory** is equipped with two 60,000 lb testing machines and a wide range of vibrators and vibration pick-ups, strain gauges, as well as recording equipment and other accessories. One of the oscillographs is capable of recording 18 separate indications simultaneously. A large static test jig provides a means of loading wing beams and other full scale structural members. Also available is a rig for drop-testing aircraft landing gear, and another for research in dynamic failure of aircraft structures.

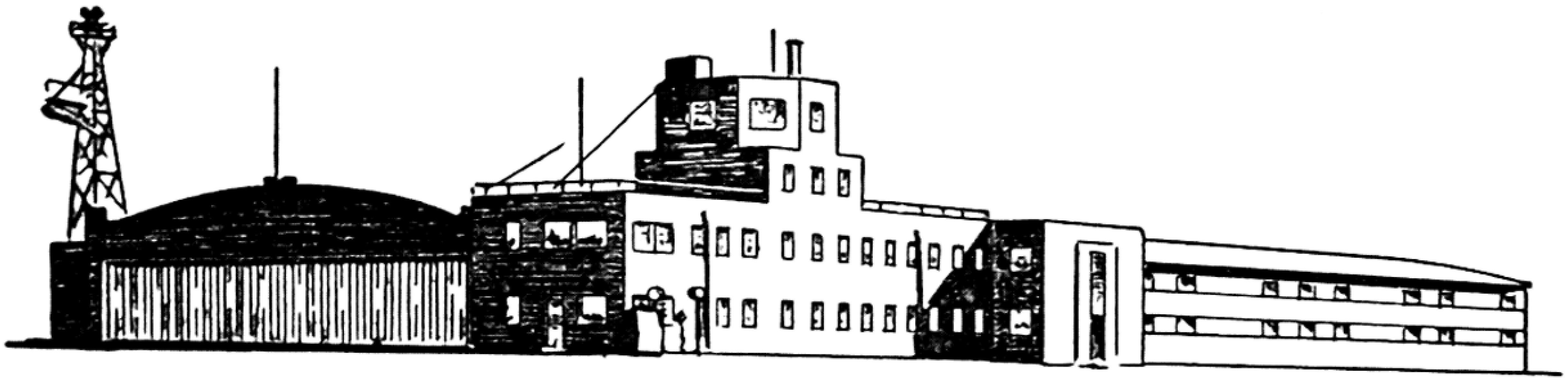
The **Air Transportation Aircraft and Engine Laboratory** is equipped with magnaflux and other inspection equipment as well as several types of aircraft and aircraft power plants ranging from the small reciprocating engines to currently used turbo-jet engines.

Computing facilities include a Reeves Electronic Analog computer and several hand calculators.

The University Airport provides a full scale laboratory of airport management for students in air transportation who are interested in this field. Meteorological information is available through the Civil Aeronautics Administration communications station located on the Airport.

AERONAUTICAL ENGINEERING

THE FIELD of aeronautical engineering includes the challenging problems encountered in the design of many types of airplanes and missiles. Supersonic speeds, guidance systems, and recent developments in propulsion put a constant demand on aeronautical research and development groups for an ever better understanding of basic physical phenomena. The aircraft industry divides its engineering jobs into the specialties of: propulsion which deals with propeller and jet engines and their component parts; structures which deals with airframe design and strength; aerodynamics which deals with airflow, the performance and flying ability of the airplane or missile; and aeroelasticity which deals with structural deflection and flutter caused by air loads. The School of Aeronautics offers two options to meet the needs of students preparing for a professional career in the research or any of the design phases of the aeronautical engineering field.



AERONAUTICS BUILDING

The Theoretical Aeronautics option is for the student who has a liking for the more technical and mathematical subjects. It provides an excellent preparation for those who desire to go on for graduate study. Graduates and those with advanced degrees are needed to do the theoretical analysis required in each of the design specialties and for the research work which lays the foundation for progress in aeronautics. The large number of elective courses in the curriculum gives the student a wide latitude in choosing his field of study. Only students with the proper academic standing may take this option.

The Airplane and Powerplant option is for the student who chooses aerodynamics, structures, or aeroelasticity as his specialty or the student who is interested in the design or installation of the many forms of powerplants used by the aeronautical engineer. The first six semesters of this option offer a thorough preparation in the fundamentals of engineering design. This background enables the student to fit into fields of engineering other than aeronautics if he chooses. In the seventh and eighth semesters a major area group is selected. This group and the elective courses offer a comprehensive background in the design specialty which the student will pursue in his professional career.

A large group of electives is available which permits a wide selection and emphasizes the breadth of interest of the aeronautical engineer.

The curriculum of aeronautical engineering is accredited by the Engineers' Council for Professional Development.

AERONAUTICAL ENGINEERING

THEORETICAL AERONAUTICS OPTION

(Total Credits—146⅔ semester hours)

FRESHMAN YEAR

(See page 13)

Students not completing (Math. 142 and Math. 241) by the end of the freshman year must make up the deficiency in calculus (Math. 241) before proceeding with the special sections of General Physics 240 and 241 which will use calculus in the analysis of physical problems. The five hours credit for advanced standing in mathematics is not included in above total for graduation.

SOPHOMORE YEAR

	Third Semester
(5)	Phys. 240 (General Physics—special section)
(4)	Math. 242 (Calculus II)
(3)	Hist. 210 (Europe Since 1914) or Hist. 205 (Europe in World Affairs)
(3)	*Spch. 114 (Prin. of Speech) or Engl. 202 (Expository Writing)
(2⅓ to 3)	*Military Training
(17⅓ to 18)	

	Fourth Semester
(5)	Phys. 241 (General Physics—special section)
(3)	Math. 431 (Intermediate Calculus)
(3)	Math. 551 (Introduction to Theoretical Statistics)
(3)	M.E. 206 (General Thermodynamics I)
(3)	E.S. 207 (Elementary Mechanics)
(2⅓ to 3)	*Military Training
(19⅓ to 20)	

JUNIOR YEAR

	Fifth Semester
(3)	Math. 525 (Applied Theory of Complex Function)
(3)	Math. 523 (Vector Analysis)
(3)	M.E. 306 (General Thermodynamics II)
(4)	E.S. 314 (Mechanics of Solids)
(4)	E.E. 412 (Electrical Engineering for Civil Engineers)
(3)	Modern Language
(20)	

	Sixth Semester
(3)	Math. 533 (Differential Equations)
(3)	E.S. 507 (Basic Mechanics III)
(3)	E.S. 532 (Theory of Material Properties)
(3)	E.E. 514 (Electronic Circuits)
(3)	Aero Technical Elective
(3)	Modern Language
(18)	

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* See notes on page 13.

SENIOR YEAR

Seventh Semester

(3)	Engl. 250 (American Books), Engl. 233 (Essay), Engl. 235 (Drama), Engl. 237 (Poetry), or Engl. 238 (Fiction)
(3)	Math. 515 (Numerical Methods in Analysis)
(3)	E.E. 515 (Electrical Measurement of Non-Electrical Quantities)
(9)	Aero Technical Electives
(18)	

Eighth Semester

(3)	Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(15)	Aero Technical Electives
(18)	

AIRPLANE AND POWERPLANT OPTION

(Total Credits—158⅔ semester hours)

FRESHMAN YEAR

(See page 13)

SOPHOMORE YEAR

Third Semester

(0)	A.E. 300 (Aviation Lectures)
(3)	•Spch. 114 (Principles of Speech) or Engl. 202 (Expository Writing)
(5)	Phys. 240 (General Physics)
(4)	Math. 241 (Calculus I)
(2)	G.E. 222 (Descriptive Geometry)
(3)	Econ. 210 (Elementary Economics)
(2⅓ to 3)	•Military Training
(19⅓ to 20)	

Fourth Semester

(5)	Phys. 241 (General Physics)
(4)	Math. 242 (Calculus II)
(5)	E.S. 204 (Statics and Kinetics)
(3)	M.E. 230 (Elementary Heat Power)
(2⅓ to 3)	•Military Training
(19⅓ to 20)	

SUMMER SHOPS

(2)	G.E. 345 (Machine Tools)
(⅔)	G.E. 251 (Aircraft Welding)
(4)	A.E. 381 (Aircraft Powerplants)
(2)	A.E. 365 (Aircraft Components)
(8⅔)	

• See notes on page 13.

JUNIOR YEAR

Fifth Semester

(3) M.E. 360 (Mechanism)
(3⅔) M.E. 310 (Fluid Mechanics)
(3) M.E. 307 (Elements of Thermodynamics)
(4) E.S. 312 (Mechanics of Materials)
(3) Math. 421 (Differential Equations)
(3) Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)

(19⅔)

Sixth Semester

(3) A.E. 310 (Aerodynamics I)
(1) A.E. 320 (Wind Tunnel Laboratory)
(3) A.E. 350 (Aircraft Structures I)
(2⅓) G.E. 266 (Aircraft Fabrication)
(3⅔) E.E. 315 (Direct Currents)
(3) Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs) or Elective
(3) A.E. 340 (Aircraft Vibrations)

(19)

SENIOR YEAR

Seventh Semester

(3) A.E. 471 (Aircraft Powerplants I)
(3⅔) E.E. 316 (Alternating Currents)
(3) Psy. 320 (Psychology for Engineers)
(3) Elective
or Hist. 210 (Europe Since 1914)
or Hist. 205 (U. S. in World Affairs)
(7) Major Area Courses

(19⅔)

Eighth Semester

(1) A.E. 498 (Aero. Engr. Seminar)
(3) Engl. 250 (Great American Books)
or Engl. 233 (Essays)
or Engl. 235 (Drama)
or Engl. 237 (Poetry)
or Engl. 238 (Fiction)
(3) Elective
(9) Major Area Courses

(16)

Typical Major Area Groups For Airplane and Power Plant Option
Aerodynamics

Seventh Semester

(3) A.E. 410 (Aerodynamics II)
(3) A.E. 450 (Aircraft Structures II) or Technical Elective
(1) A.E. 481 (Airc. Powerplant Lab.)

(7)

Eighth Semester

(3) Technical Elective
(3) Technical Elective or A.E. 450, (Aircraft Structures II)
(3) Technical Elective

(9)

At least six hours of technical electives should be chosen from the following:

(2) A.E. 420 (Aerodynamic Design of Aircraft)
(3) A.E. 530 (Aeroelasticity)
(3) A.E. 510 (Theory of Airfoil Sections)
(3) A.E. 520 (Stability and Control)
(3) A.E. 522 (Aerodynamics of Heliocopters)

Structures

Seventh Semester

(3) A.E. 410 (Aerodynamics II)
(3) A.E. 450 (Aircraft Structures II)
(1) A.E. 481 (Aircraft Powerplant Lab.)

(7)

Eighth Semester

(3) A.E. 465 (Aircraft Struct. Lab.)
(3) A.E. 550 (Aircraft Structures III)
(3) Technical Elective

(9)

Recommended Technical Electives

(3) A.E. 530 (Aeroelasticity)
(3) A.E. 460 (Aircraft Loads)
(3) A.E. 561 (Aircraft Structural Design I)
(3) A.E. 540 (Aircraft Vibrations and Dynamics)
(3) A.E. 551 (Advanced Aircraft Structures I)

Powerplants

Seventh Semester

(2) A.E. 482 (Aircraft Powerplant Lab. I)
(3) M.E. 371 (Machine Design)
(2) A.E. 466 (Aircraft Materials & Testing)

(7)

Eighth Semester

(2) A.E. 582 (Aircraft Powerplant Lab. II)
(3) A.E. 571 (Aircraft Powerplant II)
(4) A.E. 586 (Aircraft Powerplant Design)

(9)

RECOMMENDED ELECTIVES

All electives must be approved by the head of the school or someone deputized by him.

Aerodynamics

(2) A.E. 420 (Aerodynamic Design of Aircraft)
(3) A.E. 421 (Flight Testing)
(3) A.E. 530 (Aeroelasticity)
(3) A.E. 510 (Theory of Airfoil Sections)
(3) A.E. 520 (Stability and Control)
(2) A.E. 525 (Internal Aerodynamics)

Structures

(3) A.E. 460 (Aircraft Loads)
(3) A.E. 550 (Aircraft Structures III)
(3) A.E. 530 (Aeroelasticity)
(3) A.E. 551 (Advanced Aircraft Structures I)
(3) A.E. 540 (Aircraft Vibrations and Dynamics)
(3) E.S. 521 (Strength of Materials)

Advanced Mathematics

(3) Math. 521 (Advanced Engr. Math. I)
(3) Math. 522 (Advanced Engr. Math. II)
(3) Math. 520 (Partial Differential Equations)
(3) Math. 531 (Advanced Calculus)
(3) Math. 532 (Advanced Calculus)

Airplane Product Design

(3) G.E. 365 (Industrial Organization and Management)

Airline Engineering

(3) A.T. 470 (Airline Management and Operation)
(3) A.T. 480 (Airport Operation and Control)
(3) A.T. 471 (Air Traffic and Cargo)
(3) A.E. 421 (Flight Testing and Flight Instrumentation)

Powerplants

(3) A.E. 577 (Aircraft Powerplant Installation)
(3) A.E. 501 (Aircraft Control Equipment)
(3) M.E. 505 (Heat Transmission)
(3) M.E. 562 (Vibrations)
(3) M.E. 500 (Thermodynamics)
(3) E.E. 515 (Electrical Measurement of Non-Electrical Quantities)

Physics

(3) Phys. 501 (Survey of Theoretical Physics)
(3) Phys. 502 (Survey of Theoretical Physics)
(3) Phys. 550 (Introduction to Modern Physics)
(3) Phys. 556 (Introduction to Modern Physics)
(3) Phys. 555 (Nucleonics for Engineers)

AIR TRANSPORTATION

In the several years during and since World War II, air transportation has become one of the most important factors affecting the social, economic, and political well-being of the whole world. In order to provide the special preparation desirable for the student who intends to enter the general field of aviation business, a curriculum leading to the degree of Bachelor of Science in Air Transportation is offered.

Air transportation includes the following major categories:

1. The airline industry which is concerned with the transporting of passengers and cargo by air.

2. The municipal airports and air-terminals which provide the landing and take-off facilities for aircraft, primarily those of scheduled airlines, and operate or subcontract those many business activities which are associated with overall airport operation, as for example, the supplying of food for the public using the airport.

3. The nation-wide, privately owned airports and fixed-base operations which are concerned primarily with providing landing and take-off facilities for the large number of privately owned aircraft, and handling the maintenance and repair of such aircraft; the selling of aircraft; and offering flight instruction to the general public.

4. The national and state governmental aviation agencies which promote, regulate, and supervise air transportation.

To provide a balanced curriculum as a preparation for a career in air transportation, the usual required educational courses of the non-engineering college curriculum are supplemented with additional groups of courses dealing with aircraft and aviation operation including maintenance, and courses giving a background for administrative positions in business and industry.

Two options, beginning in the sophomore year, are offered—Aviation Operations, and Aviation Administration.

In the Aviation Operations option, sufficient time is offered in aircraft maintenance instruction to meet the CAA requirements for Aircraft and Engine Mechanic certificates. Approximately four-fifths of this program of study includes general education, economics, business, and basic engineering courses.

The Aviation Administration option includes many courses aimed at preparing the student to engage in business and operational activities in aviation and allied fields.

To supplement the formal education obtained in the courses included in the curriculum, inspection trips are made to airline and airport activities in Chicago and Indianapolis. Longer trips, by air, have been made in order that the student may become aware of the widespread nature, the complexity, and the potential of air transportation.

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AIR TRANSPORTATION

AVIATION OPERATIONS OPTION

(Total Credits—148⅔ Semester Hours)

FRESHMAN YEAR

(See page 13)

Freshman students entering Purdue and choosing the Air Transportation Curriculum will enroll in the Freshman Engineering Curriculum.

SOPHOMORE YEAR

	Third Semester
(0)	A.T. 230 (Air Transp. Lect.)
(4)	Phys. 220 (General Physics)
(3)	A.T. 226 (General Meteorology)
(3)	Econ. 210 (Principles of Economics)
(3)	Engl. 202 (Expository Writing) or *Spch. 114 (Principles of Speech)
(3)	Govt. 301 (Elements of Democracy)
(2⅓ to 3)	*Military Training
(18⅓ to 19)	

	Fourth Semester
(4)	Phys. 221 (General Physics)
(5)	A.T. 256 (Aircraft Engines)
(5)	A.T. 257 (Aircraft Engine Accessories)
(3)	A.T. 211 (Principles of Flight)
(2⅓ to 3)	*Military Training
(19⅓ to 20)	

JUNIOR YEAR

	Fifth Semester
(5)	A.T. 362 (Aircraft Systems and Installations)
(3)	Hist. 210 (Europe Since 1914), or Hist. 205 (U. S. in World Affairs)
(2)	G.E. 336 (Aircraft Welding and Materials)
(3)	G.E. 347 (Aircraft Fabrication)
(3)	E.S. 210 (Engineering Mechanics)
(3)	Psy. 120 (Elementary Psychology)
(19)	

	Sixth Semester
(3)	Spch. 325 (Business & Professional Interview)
(3)	A.T. 365 (Elementary Aircraft Struct.)
(3)	Econ. 470 (Business Law)
(9)	†Electives
(18)	

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* See notes on page 13.

† See page 23.

SENIOR YEAR

Seventh Semester

(3)	Econ. 520 (Government and Business)
(3)	A.T. 470 (Airline Management)
(3)	Engl. 250 (Great American Books) Engl. 233 (Essays) Engl. 235 (Drama) Engl. 237 (Poetry) or Engl. 238 (Fiction)
(2)	C.E. 463 (Airport Selection & Layout)
(3)	Econ. 370 (Elements of Accounting 1)
(2)	Econ. 473 (Aviation Law)
(3)	*Elective
(19)	

Eighth Semester

(3)	A.T. 471 (Air Traffic & Cargo)
(3)	A.T. 480 (Airport Operation & Control)
(3)	Econ. 422 (Air Transportation Economics)
(3)	Econ. 450 (Labor Economics)
(6)	*Elective
(18)	

AVIATION ADMINISTRATION OPTION

(Total credits—146⅔ semester hours)

FRESHMAN YEAR

(See page 13)

Freshman students entering Purdue and choosing the Air Transportation Curriculum will enroll in the Freshman Engineering Curriculum.

SOPHOMORE YEAR

Third Semester

Same as
Aviation Operations
Option

Fourth Semester

(4)	Phys. 221 (General Physics)
(3)	A.T. 260 (Airframe Components & Installations)
(3)	A.T. 211 (Principles of Flight)
(3)	Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs)
(3)	A.T. 250 (Aircraft Powerplants)
(2⅓ to 3)	†Military Training
(18⅓ to 19)	

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* See page 23.

† See notes on page 13.

JUNIOR YEAR

Fifth Semester

(3) Econ. 401 (Economic Statistics)
(3) Psy. 120 (Elementary Psychology)
(3) Engl. 250 (Great American Books), Engl. 233 (Essays), Engl. 235 (Drama), Engl. 237 (Poetry), Engl. 238 (Fiction)
(3) Spch. 325 (Business & Professional Interview)
(3) Econ. 450 (Labor Economics)
(3) Econ. 370 (Elements of Accounting I)

(18)

Sixth Semester

(3) Econ. 470 (Business Law)
(3) Econ. 371 (Elements of Accounting II)
or Econ. 570 (Cost Accounting)
(3) Engl. 420 (Business Writing, Gen.)
(3) Econ. 562 (Economics of Marketing)
or Econ. 382 (Economic Geography)
or Econ. 584 (World Economics)
(3) Psy. 570 (Personnel Psychology)
(3) Elective

(18)

SENIOR YEAR

Seventh Semester

(3) Econ. 520 (Govt. & Business)
(3) A.T. 470 (Airline Management)
(3) Spch. 520 (Group Discussion)
or Spch. 510 (Logical Anal. & Arg.)
(2) Econ. 473 (Aviation Law)
(2) C.E. 463 (Airport Selection)
(3) Econ. 540 (Corp. Finance)
(3) Elective

(19)

Eighth Semester

(3) A.T. 471 (Air Traffic & Cargo)
(3) Econ. 422 (Air Transportation Economics)
(3) A.T. 480 (Airport Operation)
(9) Elective

(18)

RECOMMENDED ELECTIVES

The student is advised to select his electives from the following list, taking into consideration his interests and also his previous scholastic record. All electives must be approved by the head of the school or someone deputized by him.

Semi-Technical or Technical Elective Courses

Math. 241	Calculus I
Math. 242	Calculus II
M.E. 230	Elementary Heat Power
M.E. 307	Elements of Thermodynamics
E.E. 313	Applied Electricity
E.S. 210	Engineering Mechanics
A.T. 365	Elementary Aircraft Structures
G.E. 365	Industrial Organization and Management
G.E. 585	Industrial Relations
G.E. 575	Motion and Time Study

*Non-Technical Elective Courses

†A.T. 355	Aircraft Powerplant Maintenance
†A.T. 361	Aircraft Maintenance
A.T. 492	Special Problems in Air Transportation
Soc. 100	Introductory Sociology
Soc. 565	Social and Community Surveys
Econ. 530	Money and Banking
Econ. 553	Labor Law
Econ. 551	Advanced Labor Economics
Econ. 516	Current Economic Problems
Econ. 545	Insurance Principles
Psy. 574	Psychology of Industrial Training
Spch. 230	Radio Speaking and Broadcasting Methods
Spch. 531	Radio Program Production
Engl. 412	Newspaper and Magazine Article Writing
Engl. 420	Business Writing: General Application
Engl. 515	Business Writing: Journalistic Applications
Econ. 571	Advanced Cost Accounting
Govt. 580	Public Administration

Modern Language (French, Spanish, Portuguese)

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* Descriptions of English, economics, government, speech, sociology and mathematics courses listed above will be found in the catalog of the School of Science, Education, and Humanities.

† These courses needed to meet requirements for Aircraft Engine Mechanics Certificate.

AGRICULTURAL ENGINEERING

The Schools of Engineering and the School of Agriculture offer an eight-semester-plus-summer-session plan of study leading to the degree of Bachelor of Science in Agricultural Engineering. Students wishing to take this curriculum should enter as freshmen in the Schools of Engineering and follow the curriculum outlined on page 13.

This curriculum prepares the student for engineering service in rural communities; for teaching, research, and extension work with colleges, experiment stations and governmental agencies in the fields which require engineering application; for positions in the manufacture and sale of farm machinery and farm-power equipment; for advisory and managerial posts in connection with agricultural development; for positions with farm buildings and materials concerns; and in the increasing use of electricity in agriculture.

The curriculum in Agricultural Engineering is fully accredited by the Engineers' Council for Professional Development.

The curriculum of Agricultural Engineering functions as a joint activity of the Schools of Engineering and School of Agriculture and the department is housed in a separate building located on the South Campus.

In addition to the laboratories listed below students in Agricultural Engineering make use of the laboratories of General Engineering, Civil Engineering, Engineering Sciences, Electrical, and Mechanical Engineering.

Agricultural Engineering Laboratories

Laboratories functioning under the supervision of the Agricultural Engineering staff include:

Farm Machinery Laboratory—Equipped with modern types of field machinery and tractors for use in the study of the design and operation of agricultural equipment.

Farm Power Laboratory—Individually mounted engines and accessories used by students in the study of agricultural power.

Farm Electrical Equipment Laboratory—Included in this laboratory are many types of modern electrical equipment for the farmstead and the home. Instruments and test devices for making performance tests are also provided.

Water Systems Laboratory—Provided with modern types of water systems installed for class study and laboratory tests.

Crop Drying Laboratory—Specially equipped for laboratory exercises in crop drying including apparatus and equipment for the determination of moisture contents, rates of drying and cooling grains, and for air flow measurements in bulk drying.

Material Utilization Laboratory—Essentially a research laboratory but used for special student problems. Current research is being conducted in the possible uses of agricultural products for the manufacture of a low-cost building board or panel.

(Total credits—159⅔ semester hours)

FRESHMAN YEAR

(See page 13)

SOPHOMORE YEAR

Third Semester

(5)	Phys. 240 (General Physics)
(4)	Math. 241 (Differential Calculus)
(3)	*Spch. 114 (Principles of Speech) or Engl. 250 (American Books), Engl. 233 (Essays), Engl. 235 (Drama), Engl. 237 (Poetry) or Engl. 238 (Fiction)
(0)	Agr. 101 (Agricultural Lectures)
(1)	Ag. E. 205 (Agricultural Engineering Problems)
(3)	Agron. 105 (Crop Production)
(2⅓ to 3)	*Military Training
(18⅓ to 19)	

Fourth Semester

(5)	Phys. 241 (General Physics)
(4)	Math. 242 (Integral Calculus)
(4)	Btny. 103 (Fundamentals of Plant Science)
(3)	Ag. E. 235 (Agricultural Machinery)
(2⅓ to 3)	*Military Training
(18⅓ to 19)	

SUMMER SESSION

(5)	E.S. 204 (Statics and Kinetics)
(2)	G.E. 345 (Machine Tools)
(3)	Econ. 210 (Elementary Economics)
(10)	

JUNIOR YEAR

Fifth Semester

(1)	C.E. 331 (Testing Materials)
(3)	E.S. 313 (Mechanics of Materials)
(3)	M.E. 230 (Elementary Heat Power)
(3⅔)	E.E. 315 (Direct Currents)
(3)	Ag. E. 325 (Soil and Water)
(3)	Agron. 260 (Soils)
(3)	Hist. 205 (U. S. in World Affairs) or Hist. 210 (Europe since 1914)
(19⅔)	

Sixth Semester

(3)	M.E. 307 (Elements of Thermodynamics)
(3⅔)	E.E. 316 (Alternating Currents)
(3)	Ag. E. 355 (Farm and Home Utilities)
(3)	Ag. Econ. 410 (Farm Organization) or Ag. Econ. 320 (Marketing Farm Products)
(3)	Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3)	Technical Elective
(13⅔)	

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* See notes on page 13.

SUMMER EXPERIENCE

Ten weeks of approved farm experience will be required of every student who was not farm-reared; or, for those with farm background, the requirement will be ten weeks of industry or approved agricultural engineering application.

SENIOR YEAR

	Seventh Semester
(3⅔)	M.E. 310 (Fluid Mechanics)
(3)	Ag. E. 445 (Farm Power)
(3)	Ag. E. 475 (Farm Structures)
(3)	Ag. Econ. 501 (Agricultural Statistics)
(3)	An. Husb. 301 (Livestock Management)
(3)	Technical Elective
(18⅔)	

	Eighth Semester
(3)	Ag. E. 455 (Farm Processing)
(1)	Ag. E. 496 (Seminar)
(3)	Dy. Husb. 408 (Milk Production)
(3)	Engl. 202 (Expository Writing)
(3)	Psy. 320 (Psychology for Engineers)
(3)	Hort. 318 (General Horticulture)
(3)	Technical Elective
(19)	

CHEMICAL AND METALLURGICAL ENGINEERING

THE SCHOOL OF CHEMICAL AND METALLURGICAL ENGINEERING offers undergraduate and graduate degrees in Chemical Engineering and in Metallurgical Engineering.

Chemical and Metallurgical Engineering Laboratories

Unit Operations Laboratory. This laboratory contains both small and large scale apparatus for study of physical changes in evaporation, distillation, heat transfer, fluid flow, drying, filtration, crushing, grinding, and size separation.

Unit Process Laboratory. This laboratory consists of pilot size equipment where the student studies reactions involved in making chemicals in quantities such as starting with a crude like benzene and carrying it through benzene-sulfonate to phenol and then on to phenol-formaldehyde resin.

Special Laboratories. A number of laboratories are provided for instruction and research at the graduate level in both Chemical Engineering and Metallurgical Engineering.

Gas Laboratories. Special facilities are provided for training and research in problems pertaining to the manufacture and utilization of gaseous fuels.

Instrumentation Laboratory. Bench scale apparatus simulate plant conditions in controlling temperature, flow, pH, pressure, level and other quantities by on-off, proportioning, reset and rate action devices.

Metallurgical Laboratories. Both small and large laboratories are well equipped with apparatus for use by metallurgists in physical metallurgy, production metallurgy and research. Electric melting and induction furnaces are available.

Heat Treating Laboratory. This laboratory is equipped with gas and electrically heated furnaces, high powered specialized microscopes with quartz lenses and other equipment used in studying the effect of heat treating on metals.

High Pressure Laboratory. This is equipped for research in the measurement of physical and thermodynamic properties of gases and liquids, and for the study of reaction kinetics at elevated temperatures and pressures, up to 50,000 lbs./sq. in.

Air Flow Laboratory. Preheated air at 15 lbs./sq. in. and at 2 lbs./sq. in. is provided for experiments on turbulent mixing, spray drying, slab drying, combustion, cyclone separation and the like.

Engineering and Economic Geology Laboratory. Laboratories are provided for the study of the engineering and economic aspects of geology for the Science, Education, and Humanities; Agriculture; and Engineering Schools.

Machine Shop. A complete service shop with a skilled mechanic in charge is available for building new equipment and keeping existing equipment in good operating condition.

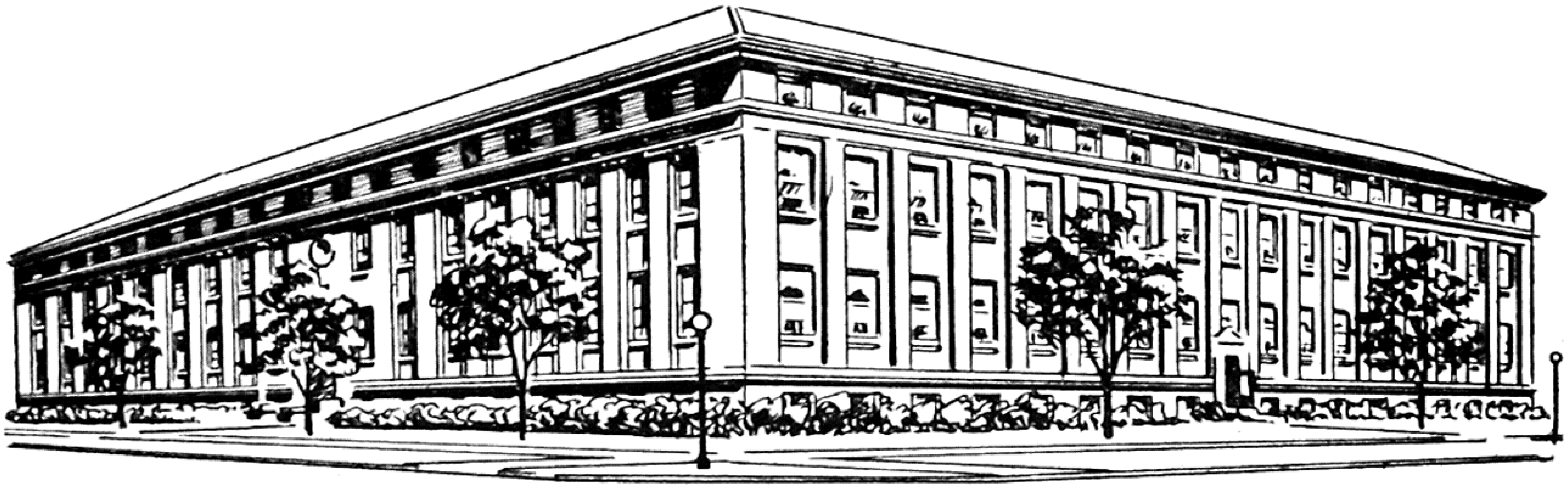
Student Shop. A shop is available for the construction of special apparatus by the student when needed in his laboratory work.

CHEMICAL ENGINEERING

THE CHEMICAL ENGINEERING curriculum is designed to prepare engineers for service in chemical industries and plants utilizing the application of chemistry in their manufacturing processes. The preparation of the chemical engineer includes both engineering and chemistry. The curriculum includes basic courses in mathematics, physics, mechanics, electricity and metallurgy, to supplement the courses in chemistry and chemical engineering. Courses in English, economics, government, history, and non-technical electives provide a background in the humanities for the chemical engineer. Laboratory courses utilizing pilot plant equipment required in the summer between the junior and senior years offer experience useful in understanding industrial factors.

Approximately half of the chemical engineers graduated are engaged in the supervision of plants manufacturing chemicals and allied products. The remainder are employed in industries utilizing chemical processes or in college teaching and research. These industries are growing rapidly and many new products are being placed on the market. They spend much time and money on research leading to new products, in the development of new processes through the pilot plant stage, on the design of new plants, on the operation of these plants and on the sales of products. All of these phases offer positions of responsibility and interest to the chemical engineer according to his training and inclination. Old and new uses of chemicals and products requiring chemicals in their manufacture result in an increasing demand for chemical engineers.

Many graduates in Chemical Engineering supplement their undergraduate education with a graduate program. The student who wishes to do research or development work, or college teaching, will find it advantageous to obtain a graduate degree. The degrees of Master of Science in Chemical Engineering and Doctor of Philosophy are offered.



CHEMICAL AND METALLURGICAL ENGINEERING BUILDING

Students who have completed high school chemistry in a recognized high school and receive high scores in the orientation tests, given at the time they enter the University, are urged to elect Chem. 117 and 118 in the freshman year.

Engineering students will be accepted for admission to the curriculum in Chemical Engineering during the second semester of their freshman year, effective at the beginning of the third semester, provided they have credits at that time in Chem. 117 with a grade of D or better, or Chem. 101 with a grade of C or better. Students who do not meet these requirements must have the approval of the head of the School of Chemical and Metallurgical Engineering before being admitted to the curriculum of Chemical Engineering.

Inspection trips to representative industrial plants are required in the 6th and 7th semesters.

The curriculum of Chemical Engineering is accredited by the Engineers' Council for Professional Development.

CHEMICAL ENGINEERING

(Total credits—158⅓ semester hours)

FRESHMAN YEAR

(See page 13)

SOPHOMORE YEAR

	Third Semester		Fourth Semester
(3)	Ch.E. 201 (Chemical Engineering Calculations)	(3)	Ch.E. 202 (Elementary Chemical Engineering Thermodynamics)
(4)	Chem. 226 (Qualitative Analysis)	(4)	Chem. 227 (Quantitative Analysis)
(4)	Math. 241 (Differential Calculus)	(4)	Math. 242 (Integral Calculus)
(4⅓)	Phys. 230 (General Physics)	(4⅓)	Phys. 231 (General Physics)
(2⅓ to 3)	• (Military Training)	(2⅓ to 3)	• (Military Training)
(17⅔ to 18⅓)		(17⅔ to 18⅓)	

• See notes on page 13.

JUNIOR YEAR

Fifth Semester

(4)	Chem. 573 (Physical Chemistry)
(4)	Chem. 551 (Organic Chemistry)
(3)	E.S. 203 (Statics and Mechanics of Materials)
(3)	Ch.E. 537 (Unit Operations)
(3)	Met.E. 303 (Properties of Metals and Alloys)
(3)	Engl. 202 (Expository Writing)
(20)	

Sixth Semester

(4)	Chem. 574 (Physical Chemistry)
(4)	Chem. 552 (Organic Chemistry)
(3)	E.S. 304 (Dynamics)
(3)	Hist. 210 (Europe Since 1914), Hist. 205 (U.S. in World Affairs), Govt. 301 (Elements of Democracy), or Govt. 331 (International Relations)
(3)	Ch.E. 538 (Unit Operations)
(⅓)	Ch.E. 390 (Inspection Trips and Professional Guidance)
(3)	Ch.E. 555 (Engineering Instrumentation) or Ch.E. 410 (Chemical Engineering Thermodynamics)
(20⅓)	

SUMMER SESSION

(2)	Ch.E. 539 (Unit Operations Laboratory)
(2)	Ch.E. 540 (Unit Operations Laboratory)
(3)	Econ. 210 (Principles of Economics)
(3)	Spch. 114 (Principles of Speech) or English 250 (American Books), English 233 (Essays), English 235 (Drama), English 237 (Poetry) or English 238 (Fiction)
(10)	

SENIOR YEAR

Seventh Semester

(3⅔)	E.E. 315 (Direct Currents)
(3)	Ch.E. 410 (Chemical Engineering Thermodynamics) or Ch.E. 555 (Engineering Instrumentation)
(3)	Ch.E. 528 (Chemical Process Industries)
(⅓)	Ch.E. 490 (Inspection Trips and Professional Guidance)
(3)	Non-Technical Elective
(3)	Technical Elective
(3)	Elective
(19)	

Eighth Semester

(3⅔)	E.E. 316 (Alternating Currents)
(3)	Ch.E. 529 (Chemical Process Industries)
(1)	Chem. 413 (Chemical Literature)
(3)	Ch.E. Elective
(3)	Non-Technical Elective
(3)	Technical Elective
(16⅔)	

RECOMMENDED ELECTIVES

Lists are available suggesting technical electives for a number of programs of interest to chemical engineers. Examples are as follows:

Advanced Chemical Engineering: Ch.E. 526, Ch.E. 527, Ch.E. 542, Ch.E. 558
Production and Sales: G.E. 569, G.E. 585
Bio-engineering: Bact. 211, Chem. 533
Nuclear Engineering: Math. 421, Chem. 571, Ch.E. 544, E.S. 581
Electrochemistry: Ch.E. 541, Met.E. 517, Chem. 571
Process Control Engineering: E.E. 515, E.E. 516, Ch.E. 527
Metallurgical Engineering: Met.E. 454, Met.E. 557.

Preparation for Chemical Engineering Graduate Program: Students with a cumulative index of 4.5 or better, who are interested in the more creative and technical phases of engineering such as research, development, design, and teaching, are advised to follow a program leading to the degree of Master of Science in Chemical Engineering or Doctor of Philosophy. It is recommended that such students take Chemical German, Germ. 151-152, as non-technical electives, and Differential Equations, Math. 421, or Intermediate Calculus, Math. 431, as a technical elective. Other suggested technical electives include Ch.E. 510, Ch.E. 527, Chem. 563 or Phys. 501.

Descriptions of chemistry, mathematics, bacteriology, and physics courses listed as electives will be found in the catalog of the School of Science, Education and Humanities.

METALLURGICAL ENGINEERING

Modern civilization consumes ever-increasing quantities of metals and every major technological advance places new requirements on metal performance and metal properties. Thus, metallurgical engineering covers a wide range of processes and large-scale industrial activities, including principally: extraction of metals from ores by mechanical concentration processes and chemical processes (smelting, leaching, electrolysis); refining of metals by means of high temperature chemical reactions or by electrolysis; and adapting the metal to its ultimate use by alloying, casting, forging, extrusion, rolling, heat treating, and other processes which yield final metal products having the properties desired for the ultimate applications in structures or machines. The curriculum is designed to prepare men for careers in all branches of metallurgical engineering and for positions as metallurgists, sales engineers, managers, and executives. At the same time the curriculum furnishes a sound foundation for advanced study in the Graduate School, especially for those planning eventually to enter research and development or teaching.

Metallurgical engineers are employed in plants producing iron and steel, copper, aluminum, titanium, uranium, and all the other commercially available metals. Even more are employed in fabricating and metal-consuming industries, such as the automobile, airplane, heavy machinery, electrical equipment, and chemical industries. In much of this work, the metallurgical engineer is concerned with the selection, evaluation, and control of the properties of metals and alloys.

The first two years of the curriculum are devoted principally to basic courses in mathematics, physics, chemistry, and English, since the metallurgical engineering of today depends on a thorough grounding in the physical sciences. Metallurgy is particularly dependent on chemistry, and study of this science continues in the upper years in physical chemistry and as part of some of the metallurgical engineering courses.

Students who have completed high school chemistry in a recognized high school and receive high scores in the orientation tests given at the time they enter the University, are urged to elect Chem. 117 and 118 in the freshman year.

Engineering students will be accepted for admission to the curriculum in Metallurgical Engineering during the second semester of their freshman year, effective at the beginning of the third semester, provided they have credits at that time in Chem. 117 with a grade of D or better, or Chem. 101 with a grade of C or better. Students who do not meet these requirements must have the approval of the head of the School of Chemical and Metallurgical Engineering before being admitted to the curriculum of Metallurgical Engineering.

The courses in metallurgical engineering in the upper two years consist of two main sequences, one in physical metallurgy and metallography and the other in chemical metallurgy. In addition, the curriculum of these two years includes work in other departments in areas important to well rounded training of metallurgical engineers, in the fields of engineering sciences, electrical engineering, and chemical engineering. Provision for technical electives in the last year gives the student a chance to specialize in a particular field.

Inspection trips are made to representative industrial plants and are required in the 6th and 7th semesters.

The curriculum of Metallurgical Engineering is accredited by the Engineers' Council for Professional Development.

METALLURGICAL ENGINEERING

(Total Credits—160⅓ semester hours)

FRESHMAN YEAR

(See page 13)

SOPHOMORE YEAR

	Third Semester
(4)	Chem. 226 (Qualitative Analysis)
(4)	Math. 241 (Differential Calculus)
(4⅓)	Phys. 230 (General Physics)
(2)	Geol. 261 (Mineralogy of Ores)
(3)	*Spch. 114 (Principles of Speech) or Engl. 250 (American Books), Engl. 233 (Essays), Engl. 235 (Drama), Engl. 237 (Poetry) or Engl. 238 (Fiction)
(2⅓ to 3)	*Military Training
(19⅔ or 20⅓)	

	Fourth Semester
(4)	Chem. 227 (Quantitative Analysis)
(4)	Math. 242 (Integral Calculus)
(4⅓)	Phys. 231 (General Physics)
(3)	Met.E. 204 (General Metallurgy)
(3)	Met.E. 201 (Metallurgical Calculations)
(2⅓ to 3)	*Military Training
(20⅔ or 21⅓)	

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* See notes on page 13.

JUNIOR YEAR

Fifth Semester

(3⅔) E.E. 315 (Direct Currents)
(4) Chem. 573 (Physical Chemistry)
(3) E.S. 201 (Statistics)
(3) Met.E. 310 (Non-Ferrous Metallurgy)
(3) Met.E. 549 (Physical Metallurgy)
(3) Psy. 320 (Engineering Psychology)

(19⅔)

Sixth Semester

(3⅔) E.E. 316 (Alternating Currents)
(4) Chem. 574 (Physical Chemistry)
(2) E.S. 202 (Kinetics)
(3) Met.E. 311 (Ferrous Metallurgy)
(3) Met.E. 550 (Ferrous Metallography)
(⅓) Met.E. 390 (Inspection Trips and Professional Guidance)
(3) Non-Technical Elective

(19)

SUMMER SCHOOL

(3) E.S. 313 (Mechanics of Materials)
(3) Ch.E. 555 (Engineering Instrumentation)
(3) Met.E. 306 (Metallurgical Laboratory)

(9)

SENIOR YEAR

Seventh Semester

(3) Econ. 210 (Principles of Economics)
(3) Engl. 202 (Expository Writing)
(2) Ch.E. 443 (Fluid Flow and Heat Transfer)
(3) Govt. 301 (Elements of Democracy) or 331 (International Relations)
(1) Geol. 462 (Crystallography)
(3) Met.E. 551 (Non-Ferrous Metallography)
(⅓) Met.E. 490 (Inspection Trips and Professional Guidance)
(3) Technical Elective

(18⅓)

Eighth Semester

(3) Hist. 210 (Europe Since 1914) or 205 (U. S. in World Affairs)
(3) Phys. 540 (X-Ray Technology)
(2) Met.E. 507 (Plastic Metallurgy)
(3) Non-Technical Elective
(6) Technical Electives

(17)

CIVIL ENGINEERING

The Civil Engineering profession is the oldest branch of the broad field of engineering, offering its members satisfaction in conceiving, planning, building and operating a large variety of establishments, works and systems essential to initiating and supporting modern civilization.

Because of the nature and extensive scope of the works in this field, the Civil Engineer does work for city, county, state, and national governments, as well as utilities or corporations. His professional talents have numerous calls from private businesses, small or medium in size, frequently providing the possibility of productive consulting practice in his special branch or field of competence.

An individual choosing this profession is afforded the privilege of unselfish and public spirited service to his fellow man and his country.

Fields in which the civil engineer is commonly engaged are: construction, highway, hydraulic, railway, sanitary and structural engineering; surveying, city planning, and soil mechanics. An engineer in one of these fields may perform one or more of the following functions within his own field or specialty: promotion, planning, research, design, construction, operation and maintenance.

The imagination, ingenuity, character, and perseverance required to conceive, design and construct the comprehensive civil works, which make it possible for modern men to live together in urban communities, challenge the most capable of our youth today.

The construction of great buildings, bridges, canals, locks, power developments, flood control works, transportation systems, sanitation systems, and even complete cities from the foundations upward find their origin in the minds and the hands of civil engineers.

The curricula in Civil Engineering are fully accredited by the Engineers' Council for Professional Development.

The School of Civil Engineering offers four plans of study each leading to a degree in Civil Engineering. The four options in this school are General, Construction, Sanitary Engineering, and Surveying and Mapping.

The first four semesters of these curricula deal primarily with fundamental engineering sciences. The last four are devoted largely to a study of the principles of practice and to an intensive training in the analysis and design of engineering structures.

The curricula offer opportunities for the students to elect courses of a nontechnical character.

The School operates the following laboratories:

Civil Engineering Laboratories

Hydraulic Laboratory. This laboratory has a flume and the necessary apparatus for calibrating current meters. An additional channel of 6 ft. depth and a maximum width of 8 ft. is available for the calibration of weirs of various sizes and shapes. Water, supplied by centrifugal, rotary, and plunger pumps with a combined capacity in excess of 13,000 gallons per minute is measured with tanks, weirs, orifices, Venturi meters, Pilot tubes, etc. The largest weighing tank has a capacity of 20 tons. Provision is made for the determination of friction losses and also to study the hydraulic gradient in a system composed of several different sizes of pipes.

The **Sanitary Engineering Laboratory** is equipped to provide facilities for conducting all the usual tests used in the operation of sewage-disposal and water-treatment works. The bacteriological laboratory is equipped with the latest and finest equipment for research in sanitary engineering. The chemical laboratory is complete in every detail, providing facilities for research on water and sewage as well as on industrial wastes. The treatment plants of the state are open to the University for inspection and special investigations.

The **Soil Mechanics Laboratory** is equipped with facilities for undergraduate and graduate instruction in soil-testing methods for engineering purposes and provides opportunities for carrying on research in soil mechanics and its application to engineering problems. The laboratory has equipment for general soil classification tests (Atterberg limit, mechanical analyses, specific gravity, compaction, etc.), and for the study of the pressure-volume relationships, the stress-strain relationships, and the strength characteristics of soils. Equipment is available for demonstration and study of the effects of flowing water on soils. In cooperation with the Joint Highway Research Project, additional facilities are available for studying the effects of temperature changes on soils, frost, and frost action in highway subgrades.

The **Structural Models Laboratory** is equipped with testing machines, mechanical and electrical strain gauges, deformers, etc., for studying analysis and design of structural members, components and models.

The **Structural Vibrations and Impact Laboratory** is equipped with facilities for studying structural vibrations and impact: (a) models of beams, frames, etc.; (b) oscillators, shake table, etc.; (c) vibration analyzers, dynamic electric strain gauges, and deflectometers.

The **Structures Laboratory** consists of a room 60 feet by 60 feet with a heavily reinforced concrete floor 30 inches thick, supported by two five by seven feet reinforced concrete beams. A 600,000 pound (capacity) Baldwin-Southwark, universal, hydraulic testing machine is carried on the floor and beams. This machine has a vertical clearance of 22 feet and a horizontal clearance of six feet. It is equipped with an elevator of 6,000 pounds capacity.

The laboratory also contains a 120,000 pound, universal, hydraulic testing machine and a Krouse-Purdue fatigue machine of 60,000 pounds capacity, push or pull. It can be operated hydraulically up to 500 reversals per minute or mechanically at 1,000 reversals per minute.

Anchors on six foot centers in both directions capable of taking 100,000 pounds each either vertically or horizontally are provided in the concrete floor. The laboratory is served by a two ton traveling crane. Complete instrumental equipment is provided.

The **Testing Materials Laboratory** is equipped for the delicate measurements of the physical properties of materials of construction, and for tests on manufactured pieces requiring machines of large capacity. The equipment includes ten universal testing machines of standard construction ranging from 3,000 to 300,000 pounds capacity, for making tension, compression, flexture, and torsion tests. An Izod-Charpy-Tension and a Hatt-Turner impact machine are used in determining the behavior of materials under shock.

Highway Research Laboratories

Highway Research Laboratories consist of adequately equipped airphoto interpretation, bituminous and paint, chemical, concrete, and soil laboratories devoted to highway, railroad, and airport research. In addition, there are facilities for transportation and traffic studies, a shop tooled for light carpentry and machine work, and a small tract of land suitable for test sections and other field studies. All laboratories have been established as facilities of the Joint Highway Research Project which are operated by the School of Civil Engineering in cooperation with the State Highway Commission of Indiana. The activities of the Highway Research Laboratories include the following:

The **Airphoto Interpretation Laboratory** provides facilities for the functions of instruction and research in the use of aerial photographs for evaluating soil, rock, and drainage conditions relevant to highway and airport location. Important among these facilities are a photographic dark room installation, and a comprehensive library of selected photographic prints from all sections of the United States and many parts of the world.

The **Bituminous and Paint Laboratory** is equipped to perform all standard tests. In these areas, also, facilities are at hand for testing bituminous-aggregate mixtures—including compression machine for triaxial and Marshall stability tests —and conducting weathering experiments with accelerated weathering machine, refrigerator, and moist room.

The **Chemical Laboratory** provides facilities needed to perform general gravimetric and volumetric analyses, with many specialized items being readily available through loan from the general Chemistry, Physics and Heat Transfer Laboratories of the University.

The **Concrete Laboratory** is equipped to make all standard tests of cement, concrete and aggregates. In addition extensive temperature and moisture control facilities are available for freezing and thawing tests of concrete and aggregate durability, plus instruments for determining the dynamic modulus of elasticity of concrete, vacuum saturation apparatus, and air meters.

The **Soil Laboratory** provides the necessary apparatus for performing soil identification and classification tests, and equipment for measuring strength and compaction characteristics. Included is a three-table hydraulic compression testing machine, which is used for triaxial and California Bearing Ratio testing of soils. For field studies such items as automatic subgrade temperature recorders and soil profile drill tools are available.

The Traffic Engineering Laboratory provides facilities for measuring speed, acceleration, lateral position on the roadway, driver reaction time, driver vision skid resistance, and others.

David E. Ross Summer Surveying Camp

In 1926, through the generosity of David E. Ross, the University acquired title to a 140 acre farm about 12 miles southwest of West Lafayette. In 1931 Mr. Ross added 80 acres to this tract. These 220 acres of typical Wabash River bottom land and bluffs have been set aside for a permanent Civil Engineering Summer Surveying Camp.

The rugged terrain of the camp site provides an ideal outdoor laboratory for the development of the essential basic skills of the surveyor and topographic engineer.

The physical plant at the site has been improved each year through the efforts of staff and students until at present there exists a farmstead which is used by a caretaker, a mess hall, barracks, recitation building, bath house and swimming pool. Members of the camp faculty occupy a small cottage. Health principles are emphasized by an adequate chlorinated water supply, necessary sewage disposal facilities and proper refrigeration units in the kitchen. Individuals from the Home Economics cafeteria staff, guided by a competent dietitian, operating in a well-planned modern kitchen, provide excellent meals for members of the camp.

Facilities at the camp provide for a student population of 170 but are such that they can be expanded to take care of 250.

CIVIL ENGINEERING

GENERAL OPTION

(Total credits—155 semester hours)

FRESHMAN YEAR

(See page 13)

SUMMER CAMP

(8) (C.E. 102 and 104) Summer Surveying Camp.

SOPHOMORE YEAR

Third Semester

(2)	G.E. 222 (Descriptive Geometry)
(4)	Math. 241 (Calculus I)
(4⅓)	Phys. 230 (General Physics)
(3)	*Spch. 114 (Principles of Speech) or Engl. 250 (American Books), Engl. 233 (Essay), Engl. 235 (Drama), Engl. 237 (Poetry), or Engl. 238 (Fiction)
(2)	C.E. 262 (Railroads)
(2⅓ to 3)	*Military Training
(17⅔ to 18⅓)	

Fourth Semester

(5)	E.S. 204 (Statics and Kinetics)
(4)	Math. 242 (Calculus II)
(4⅓)	Phys. 231 (General Physics)
(3)	Engl. 202 (Expository Writing)
(2⅓ to 3)	*Military Training
(18⅔ to 19⅓)	

JUNIOR YEAR

Fifth Semester

(5⅓)	C.E. 370 (Stresses)
(2)	C.E. 268 (Highway Construction)
(4)	E.S. 312 (Mechanics of Materials)
(3)	M.E. 230 (Elementary Heat Power)
(3)	Econ. 210 (Economics)
(17⅓)	

Sixth Semester

(4)	C.E. 335 (Engineering Materials)
(3)	C.E. 341 (Hydraulics)
(1)	C.E. 349 (Hydraulic Laboratory)
(2)	C.E. 269 (Highway Construction)
(3)	C.E. 371 (Indeterminate Stresses)
(2)	Geol. 341 (Engineering Geology)
(3)	Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs)
(18)	

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* See notes on page 13.

SENIOR YEAR

Seventh Semester

(2)	Technical Elective
(3)	C.E. 480 (Soil Mechanics)
(4⅓)	C.E. 459 (Water Supply and Sewerage)
(4)	C.E. 474 (Theory of Reinforced Concrete)
(3)	Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3)	Non-technical Elective
(19⅓)	

Eighth Semester

(2)	Technical Elective
(4)	E.E. 421 (Electrical Engineering for Civil Engineers)
(3)	C.E. 424 (Contracts and Specifications)
(3)	Psy. 320 (Psychology for Engineers)
(4)	C.E. 478 (Structural Design)
(3)	Non-technical Elective
(19)	

TECHNICAL ELECTIVES

The student may select technical electives from one or more of the following fields, taking into consideration his interests and previous scholastic record. •Other technical electives may be selected with the approval of the head of the school or his deputy.

Surveying and Mapping

(2)	C.E. 304 (Cartography)
(1)	C.E. 405 (Hydrographic Surveying)
(2)	C.E. 500 (Geodetic Surveying)
(2)	C.E. 501 (Photogrammetry)
(2)	C.E. 502 (Land Surveying)

Transportation Engineering

(3)	C.E. 560 (Comparative Analysis of Transportation)
(3)	C.E. 561 (Highway Motor Transportation)
(2)	C.E. 562 (Railway Engineering)
(2)	C.E. 563 (Airport Design)
(2 or 3)	C.E. 564 (Traffic Engineering)
(2)	C.E. 565 (Traffic Planning)
(2)	C.E. 568 (Highway Engineering)
(2)	C.E. 569 (Highway Engineering)
(2)	C.E. 576 (Advanced Reinforced Concrete)
(2)	C.E. 577 (Indeterminate Analysis)
(2)	C.E. 583 (Foundation Engineering)

City Planning

(2)	C.E. 502 (Land Surveying)
(2)	C.E. 506 (City Planning)
(2)	C.E. 528 (Municipal Engineering)
(2)	C.E. 553 (Sanitary Engineering)
(2)	C.E. 563 (Airport Design)
(2 or 3)	C.E. 564 (Traffic Engineering)

Structural Engineering

(2)	C.E. 476 (Timber Design)
(2)	C.E. 479 (Architectural Engineering)
(3)	C.E. 571 (Indeterminate Structures)
(2)	C.E. 572 (Structural Problems)
(1)	C.E. 573 (Structural Laboratory)
(2)	C.E. 574 (Structural Laboratory)

(2)	C.E. 567 (Introduction to Airphoto Interpretation)
(2)	C.E. 581 (Soil Testing for Engineering Purposes)
(2)	C.E. 583 (Foundation Engineering)

• Students who contemplate graduate study should choose Mathematics 421 as a substitute for one of the technical electives.

Soil Mechanics and Geology

(3) Geol. 342 (Engineering Geology)
(2) Geol. 543 (Advanced Engineering Geology)
(2) Geol. 544 (Advanced Engineering Geology)
(2) C.E. 566 (Surface Materials of the United States)

Hydraulic Engineering

(2) C.E. 542 (Hydrology)
(2) C.E. 553 (Sanitary Engineering)

Construction Engineering

(3) C.E. 426 (Construction Estimates and Costs)
(3) C.E. 428 (Construction Planning and Organization)

CONSTRUCTION OPTION

(Total credits—158 semester hours)

Freshman and sophomore years and Summer Camp are the same as in the General Option.

JUNIOR YEAR

Fifth Semester

(4) E.S. 312 (Mechanics of Materials)
(3) M.E. 230 (Elementary Heat Power)
(5⅓) C.E. 370 (Stresses)
(2) C.E. 268 (Highway Construction)
(3) Econ. 210 (Economics)
(2) Geol. 341 (Geology)

(19⅓)

Sixth Semester

(4) C.E. 335 (Engineering Materials)
(3) C.E. 341 (Hydraulics)
(1) C.E. 349 (Hydraulic Laboratory)
(2) C.E. 269 (Highway Construction)
(3) C.E. 371 (Indeterminate Stresses)
(3) Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs)
(3) Non-technical Elective

(19)

SENIOR YEAR

Seventh Semester

(4⅓) C.E. 459 (Water Supply and Sewerage)
(4) C.E. 474 (Theory of Reinforced Concrete)
(2) C.E. 479 (Architectural Engineering)
(3) C.E. 426 (Construction Estimates and Costs)
(4) E.E. 412 (Electrical Engineering)
(3) Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)

(20⅓)

Eighth Semester

(4) C.E. 478 (Structural Design)
(3) C.E. 424 (Contracts and Specifications)
(3) C.E. 428 (Construction Planning and Organization)
(2) C.E. 483 (Foundation Engineering)
(3) Psy. 320 (Psychology for Engineers)
(3) Econ. 450 (Labor Economics)

(18)

SANITARY ENGINEERING OPTION

(Total credits—155 semester hours)

Freshman year and Summer Camp are the same as in the General Option.

SOPHOMORE YEAR

Third Semester

(2)	G.E. 222 (Descriptive Geometry)
(4)	Math. 241 (Calculus)
(4⅓)	Phys. 230 (General Physics)
(3)	*Spch. 114 (Principles of Speech) or Engl. 250 (American Books), Engl. 233 (Essay), Engl. 235 (Drama), Engl. 237 (Poetry) or Engl. 238 (Fiction)
(4)	Bact. 211 (Bacteriology)
(2⅓ to 3)	*Military Training
(19⅔ to 20⅓)	

Fourth Semester

(5)	E.S. 204 (Statics and Kinetics)
(4)	Math. 242 (Calculus II)
(4⅓)	Phys. 231 (General Physics)
(3)	Engl. 202 (Expository Writing)
(2⅓ to 3)	*Military Training
(18⅔ to 19⅓)	

CIVIL ENGINEERING BUILDING

JUNIOR YEAR

Fifth Semester

(4)	E.S. 312 (Mechanics of Materials)
(5⅓)	C.E. 370 (Stresses)
(3)	C.E. 351 (Water Analysis)
(3)	Econ. 210 (Economics)
(3)	Non-technical Elective
(18⅓)	

Sixth Semester

(4)	C.E. 335 (Engineering Materials)
(3)	C.E. 341 (Hydraulics)
(1)	C.E. 349 (Hydraulic Laboratory)
(3)	C.E. 352 (Sewage Analysis)
(3)	C.E. 371 (Indeterminate Stresses)
(3)	Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs)
(17)	

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* See notes on page 13.

SENIOR YEAR

	Seventh Semester
(4⅓)	C.E. 459 (Water Supply and Sewerage)
(4)	C.E. 474 (Theory of Reinforced Concrete)
(3)	C.E. 480 (Soil Mechanics)
(2)	Geol. 341 (Engineering Geology)
(3)	Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3)	Non-technical Elective
(19⅓)	

	Eighth Semester
(2)	C.E. 553 (Sanitary Engineering)
(4)	E.E. 412 (Electrical Engineering for Civil Engineers)
(1)	C.E. 453 (Sanitary Engineering Seminar)
(4)	C.E. 478 (Structural Design)
(3)	C.E. 424 (Contracts and Specifications)
(3)	Psy. 320 (Psychology for Engineers)
(17)	

SURVEYING AND MAPPING OPTION

(Total credits—156 semester hours)

Freshman and sophomore years and Summer Camp are the same as in the General Option.

JUNIOR YEAR

	Fifth Semester
(5⅓)	C.E. 370 (Stresses)
(2)	C.E. 268 (Highway Construction)
(4)	E.S. 312 (Mechanics of Materials)
(2)	C.E. 304 (Cartography)
(3)	G.S. 355 (Astronomy)
(3)	Econ. 210 (Economics)
(19⅓)	

	Sixth Semester
(4)	C.E. 335 (Engineering Materials)
(3)	C.E. 341 (Hydraulics)
(1)	C.E. 349 (Hydraulic Laboratory)
(2)	C.E. 269 (Highway Construction)
(3)	C.E. 371 (Indeterminate Stresses)
(2)	Geol. 341 (Engineering Geology)
(3)	Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs)
(18)	

SENIOR YEAR

	Seventh Semester
(2)	C.E. 500 (Geodetic Surveying)
(3)	C.E. 480 (Soil Mechanics)
(4⅓)	C.E. 459 (Water Supply and Sewerage)
(4)	C.E. 474 (Theory of Reinforcing Concrete)
(3)	Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3)	For. 103 (Conservation)
(19⅓)	

	Eighth Semester
(2)	C.E. 501 (Photogrammetry)
(2)	C.E. 502 (Land Surveying)
(1)	C.E. 405 (Hydrographic Surveying)
(3)	C.E. 424 (Contracts and Specifications)
(3)	Psy. 320 (Psychology for Engrs.)
(4)	C.E. 478 (Structural Design)
(3)	Econ. 380 (Human Geography) or Econ. 382 (Economic Geography)
(18)	

ENGINEERING SCIENCES

The principal object of the curriculum in Engineering Sciences is to prepare students for careers in basic research and development in the engineering field. The program, therefore, emphasizes fundamental principles and techniques. These same basic principles and techniques form the foundation of all engineering endeavor.

The demand for graduate engineers trained in Engineering Sciences has grown rapidly in the past few decades. This demand will continue to grow as basic research and development play an increasingly important role in industry and government.

Graduates in Engineering Sciences find employment in the aircraft, automotive, electrical and electronics industries, in industrial and governmental research laboratories, and in many other such organizations. The broad basic training of the engineering science graduate makes him a desirable addition to almost any engineering staff. His breadth of vision of all fields of engineering often leads him to supervisory and administrative posts or to the front of a new field of engineering development.

The research engineer is primarily concerned with the analysis and synthesis of engineering structures, machines, and processes. This analysis and synthesis requires a high degree of physical insight, sound engineering judgment, and skill in the use of analytical and experimental research tools. For this reason, the curriculum in engineering mechanics contains extensive mathematics and basic science courses to develop the student's skill in precise physical reasoning, analysis and synthesis. The curriculum also contains design courses to furnish training in engineering practice, to give a knowledge of materials and to develop engineering judgment.

A student who wishes to pursue advanced studies and research in engineering sciences will find fertile fields in the following areas: dynamics, elasticity, plasticity, fluid mechanics, thermodynamics, nuclear engineering, systems analysis and synthesis, and modern computers.

The curriculum is fully accredited by the Engineers' Council for Professional Development as Engineering Mechanics.

Engineering Sciences Laboratories

The **Static Stress Analysis Laboratory** is equipped for modern methods of stress analysis, including: (a) two- and three-dimensional photoelasticity, which involves the testing of plastic models at ordinary room temperature and at elevated temperatures, with oil bath, loading dynamometers, polarized light apparatus, and photographic equipment; (b) brittle lacquer survey of stresses in complicated parts, which involve the use of controlled temperature and humidity, special sprays and special loading apparatus; (c) strain measurements by means of SR-4 electrical wire gauges with strain indicators; (d) brittle-material method of analyses, using special metals, plastics, and glass.

The **Dynamic Stress Analysis Laboratory** is equipped for electrical measurement of dynamic phenomena, including accelerations, displacements, and rapidly changing strains, pressures, and temperatures. The equipment includes: continuously recording inking galvanometers with associated carrier bridges for making low frequency measurements; cathode ray oscillographs and associated circuits suitable for making high frequency measurements; recording potentiometers for continuously sampling thermocouples; an electronic switch for high speed sampling of electrical strain gauges; representative transducers such as SR-4 strain gauges, piezoelectric crystals, thermocouples, and differential transformers for changing various mechanical phenomena into measurable electrical quantities.

The **Computer Laboratory** is equipped with an electronic analog computer, three problem boards, a segmental function generator, sine and square wave generators, cathode-ray oscillographs and direct writing galvonometers for monitoring and reading out information. This equipment makes possible the solution of certain twelfth order differential equations.

The **Experimental Engineering Science Laboratory** provides facilities to demonstrate and explore physical laws which are fundamental to engineering. Adequate equipment is available to study heat, light, electricity and the laws of dynamics.

The **Library** contains a rapidly growing collection of books and periodicals dealing with mechanics, fluid flow, dynamics, stress analysis, thermodynamics, heat transfer, solid state physics and nuclear engineering. It is used as a source of reference material for undergraduate students, graduate students and staff.

(Total credits—155⅓ semester hours)

FRESHMAN YEAR

(See page 13)

SUMMER SESSION

(4) Math. 241 (Calculus I)

Note: A summer session is not required if the student has completed Math. 241 during the freshman year.

SOPHOMORE YEAR

(3)	E.S. 205 (Basic Mechanics I)	(3)	E.S. 206 (Basic Mechanics II)
(1)	E.S. 271 (Experimental Engineering Science I)	(1)	E.S. 272 (Experimental Engineering Science II)
(3)	Engl. 202 (Expository Writing)	(4)	E.S. 314 (Mechanics of Solids)
(4)	Math. 242 (Calculus II)	(3)	Math. 431 (Intermediate Calculus)
(3)	Met.E. 345 (Elementary Metallurgy)	(3)	M.E. 206 (General Thermodynamics I)
(3)	*Spch. 114 (Principles of Speech) or Engl. 250 (American Books) Engl. 233 (Essay) Engl. 235 (Drama) Engl. 237 (Poetry) or Engl. 238 (Fiction)	(4)	E.E. 412 (Electrical Engineering for Civil Engineers)
(2⅓ to 3)	*Military Training	(2⅓ to 3)	*Military Training
(19⅓ to 20)		(20⅓ to 21)	

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* See notes on page 13.

JUNIOR YEAR

(2) E.S. 373 (Experimental Engineering Science III)
(3) Hist. 210 (Europe since 1914) or Hist. 205 (U. S. in World Affairs)
(3) Math. 523 (Vector Analysis)
(3) Math. 525 (Applied Theory of Complex Functions)
(3) M.E. 306 (General Thermodynamics II)
(3⅔) M.E. 310 (Fluid Mechanics)

(17⅔)

(1) E.S. 374 (Experimental Engineering Science IV)
(3) Econ. 210 (Economics)
(3) E.S. 507 (Basic Mechanics III)
(3) E.S. 532 (Theory of Material Properties)
(5) Math. 533X (Ordinary and Partial Differential Equations)
(3) Phys. 530 (Electricity and Magnetism)

(18)

SENIOR YEAR

(3) E.S. 471 (Engineering Research, Design & Development I)
(0) E.S. 490 (Engineering Inspection Trip—Senior Year)
(4) E.S. 543 (Continuum Mechanics I)
(3) E.S. 581 (Nuclear Engineering)
(3) Math. 515 (Numerical Methods in Analysis)
(3) Phys. 537 (Electronic Techniques for Physical Research)
(3) Non-technical Elective

(19)

(4) E.S. 472 (Engineering Research, Design & Development II)
(4) E.S. 544 (Continuum Mechanics II)
(3) E.S. 564 (Systems Analysis and Synthesis)
(3) Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3) Psy. 320 (Psychology for Engineers)
(3) Non-technical Elective

(20)

ELECTRICAL ENGINEERING

THE MAIN OBJECTIVE of the curriculum of the School of Electrical Engineering is to provide the necessary and proper training for those students who wish to prepare themselves for careers, either professional or administrative, in those fields of work which have to do with the electrical arts and sciences. The curriculum contains such general engineering and electrical engineering courses as are deemed necessary to provide the proper basic training for the foundations of such careers. To broaden the training, courses in economics, English, government, history, and psychology are required. As mathematics, drawing, and written and spoken English are the mental tools with which an electrical engineer must work, courses in these subjects are given considerable emphasis.

The field of Electrical Engineering is a broad one, and in order to provide a limited specialization of training, election of certain courses is possible in the senior year. Thus, if a student is interested in radio communication, he should select electives in this field. If he is interested in electric power transmission, then his selection should be in that field.

For those students of ability who are interested in research and development, university teaching, or in theoretical analysis or theoretical design, the

School also administers study programs leading to degrees of Master of Science in Electrical Engineering and Doctor of Philosophy with a major in Electrical Engineering. Information relative to these programs may be found in the *Graduate School Bulletin.*

Graduates of the School find employment with manufacturing companies, power and telephone utilities, broadcasting companies, governmental organizations, or in enterprises of their own. Immediately after graduation, employment is often obtained in the training departments of the larger manufacturing companies. As the graduates gain experience they advance to positions of higher responsibility, becoming, on the one hand, engineers engaged in the design, development, manufacture, sale, operation, or maintenance of the myriads of types of electrical equipment now so widely used in industrial establishments, on the farms, and in the home. On the other hand, many graduates who combine administrative ability with technical ability eventually find their way into supervisory and administrative positions such as those of chief engineer, manager, purchasing agent, treasurer, vice president, or president of an organization. Others start businesses of their own by becoming consulting engineers or organizing enterprises of their own in the industrial field.

The curriculum of Electrical Engineering is fully accredited by the Engineers' Council for Professional Development.

Electrical Engineering Laboratories

The School of Electrical Engineering maintains a number of well equipped laboratories for undergraduate and graduate instruction including:

The **A-C Network Analyzer Laboratory** is used for the analysis of complex network problems associated with the operation and design of power transmission systems. The work is conducted jointly by the University and seven interconnected power companies in Indiana and the surrounding area. In addition, the Network Analyzer Laboratory is used by the University in two graduate level courses and in research projects dealing with electric power system problems.

The purpose of the **Basic Electronics Laboratory** is to give students experience in handling electronic circuits and instruments while they are taking the first two undergraduate courses in electronics. The available equipment includes a wide assortment of electron tubes, circuit components, oscillographs, signal generators, power supplies, electro-mechanical instruments, and other measuring devices. A-c and d-c power are available to meet all requirements of the basic courses.

In the **Duncan High Voltage Laboratory** are two high-voltage testing transformers, each providing 60 cycle voltages up to 300,000 volts, a high-current generator providing surge currents up to 100,000 amperes, and an impulse generator having a rating of 3,000,000 volts.

The above facilities in conjunction with control, measuring, and recording equipment, including sphere gaps and a high-speed cathode ray oscillograph, make possible the performance of most of the standard high-voltage, high-current, and radio interference tests. The laboratory provides for instruction and research in the field of high voltage.

The **Illumination Laboratory** is equipped to provide instruction and test facilities in the fields of photometry, radiometry, color, and vision. Luminous flux, candle power, and candle power distributions are determined photoelectrically with the five-foot diameter integrating sphere and the three-meter bar photometer. Radiometric and spectroradiometric data are obtainable from a spectroradiometer. Equipment for the study of color mixing is provided as are graded color samples for color comparison and identification. A Luckiesh-Moss visibility meter is available for measurements of "seeability." A Macbeth Illuminometer enables accurate determinations of illumination, brightness, and reflection factors in the field as well as in the laboratory. Photometric and radiometric standards are maintained in the laboratory. In addition, a large variety of light sources and fixtures are available for demonstration and test purposes. Equipment is also provided for lighting surveys made outside the laboratory.

The **Industrial Electronics Laboratory** is used primarily for courses in electronic instrumentation, electronic control, and electronic power. It is also available for research work that requires its facilities. In addition to that required for formalized experiments in industrial electronics, the equipment of this laboratory includes resistance welding controls, electronic heating apparatus, photoelectric controls, a thyratron motor drive, an electrostatic dust precipitator, magnetic amplifiers, polyphase rectifiers, many laboratory instruments, and several types of electronic regulators.

In the **Measurements Laboratories** are three separate laboratories devoted to electrical measurements. Two of these are used by undergraduate students as an application of an engineering approach to measurements. The first laboratory is equipped for d-c measurements, the second for a-c measurements. In a third laboratory primary standards are maintained and repair and calibration of the instruments used in other laboratories of the School are conducted.

The **Power Laboratory** is equipped with a-c and d-c machines of the types common in industrial applications. Practice in connecting and operating these machines is provided in parallel with class room study of their principles of operation. Special machines are available for use by advanced students.

The **Communication Engineering Laboratories:** one large and well-equipped laboratory, several smaller laboratories, and a small shop provide excellent facilities for senior and graduate level instruction and for graduate research and development in the broad field of communication engineering.

Available apparatus permits demonstration, measurement, and study of the performance of a wide variety of the circuits and components involved in the transmission and reception of information. The frequency range covered extends from audio and very low frequencies well into the super high frequency region.

Students who expect to transfer to the electrical engineering curriculum after some previous collegiate study should note that there is a sequence of five required courses in electrical engineering. Since five terms of attendance are required to complete these, transfer at the beginning of a summer session is recommended.

ELECTRICAL ENGINEERING

(Total credits—151⅔ semester hours)

FRESHMAN YEAR

(See page 13)

SOPHOMORE YEAR

Third Semester

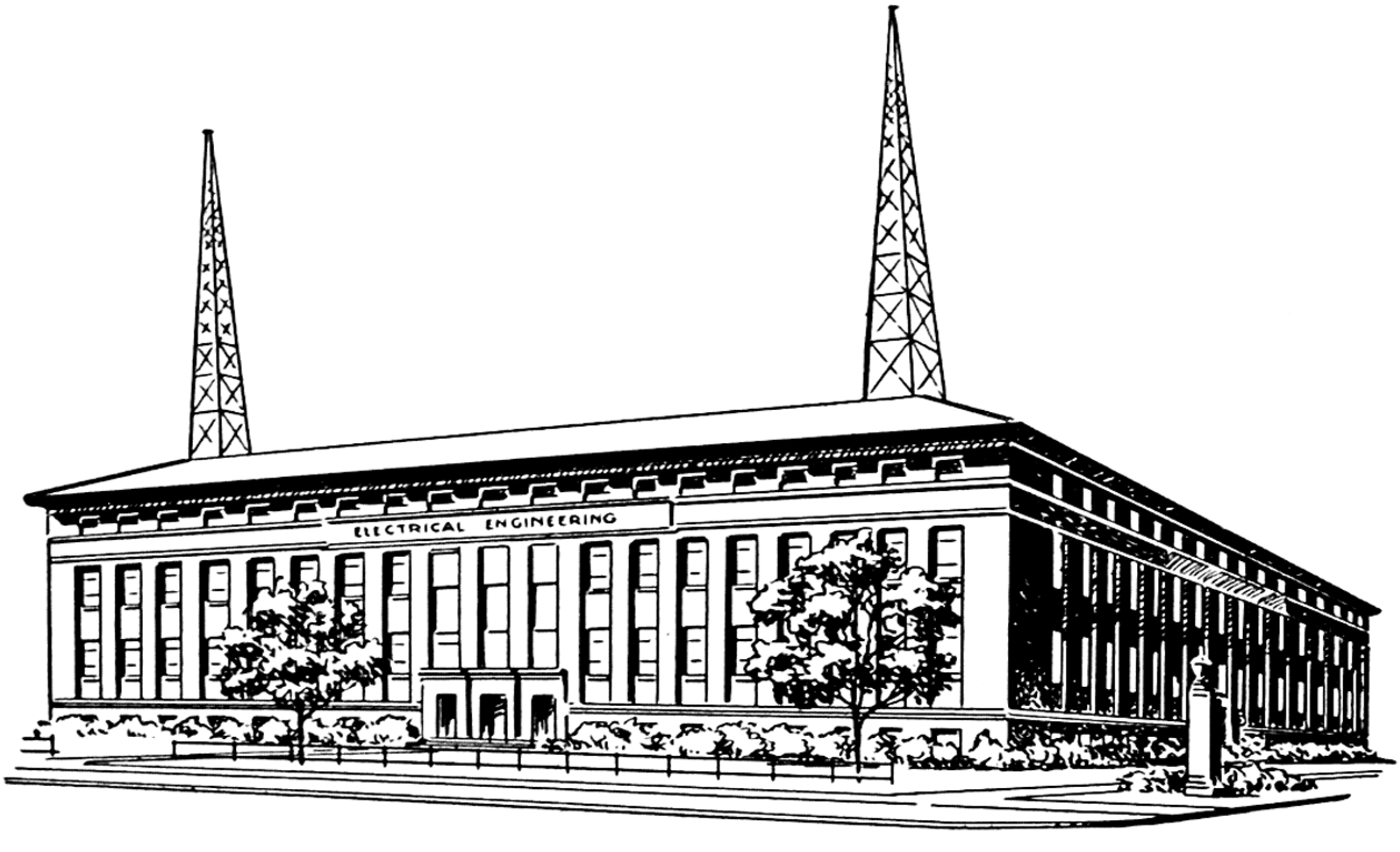
- (4) E.E. 201 (Electric and Magnetic Circuits)
- (2) G.E. 345 (Machine Tools) or G.E. 275 (Electrical Shop)
- (4) Math. 241 (Calculus I)
- (5) Phy. 240 (General Physics)
- (3) *Spch. 114 Principles of Speech) or Engl. 233 (Essay), Engl. 235 (Drama), Engl. 237 (Poetry), Engl. 238 (Fiction), or Engl. 250 (American Books)
- (2.3 or 3) *Military Training

(20.3 or 21)

Fourth Semester

- (4) E.E. 202 (Electric and Magnetic Circuits and Fields)
- (3) Engl. 202 (Expository Writing)
- (2) G.E. 275 (Electrical Shop) or G.E. 345 (Machine Tools)
- (4) Math. 242 (Calculus II)
- (5) Phy. 241 (General Physics)
- (2.3 or 3) *Military Training

(20.3 or 21)



ELECTRICAL ENGINEERING BUILDING

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* See notes on page 13.

JUNIOR YEAR

Fifth Semester

(4)	E.E. 303 (Alternating-Current Circuits I)
(3)	E.E. 306 (Electronics I)
(3)	E.E. 308 (Electrical Measurements I)
(5)	E.S. 204 (Statics and Kinetics)
(3)	*Hist. 205 (U. S. in World Affairs) or Hist. 210 (Europe since 1914)
(18)	

Sixth Semester

(4)	E.E. 304 (Alternating-Current Circuits II)
(3)	E.E. 307 (Electronics II)
(3)	E.E. 309 (Electrical Measurements II)
(3)	E.S. 313 (Mechanics of Materials)
(3)	Math. 421 (Differential Equations)
(3)	*Econ. 210 (Prin. of Economics)
(19)	

SENIOR YEAR

Seventh Semester

(4)	E.E. 405 (Alternating-Current Machines)
(3)	M.E. 230 (Heat Power)
(3)	Psy. 320 (Psychology for Engineers)
(3)	E.E. Elective
(6)	Elective
(19)	

Eighth Semester

(3)	E.E. 409 (Engineering Administration)
(3)	M.E. 307 (Thermodynamics)
(3)	Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3)	E.E. Elective
(6)	Elective
(18)	

MECHANICAL ENGINEERING

Mechanical Engineering comprises a wide range of engineering activities covering power generation, transportation, and manufacturing. The main functions of a Mechanical Engineer are the design and development of mechanical equipment and production processes, the design and operation of power plants and factories, and the management of industrial enterprises.

Among the specialized fields of mechanical engineering are power plants, including steam, hydraulic, internal combustion engine, and gas turbine plants; heating, ventilating, and air conditioning; refrigeration; railroads; machine design; production planning and control; industrial management; materials handling; rockets and jet propulsion; combustion; heat transfer; and fluid mechanics. Mechanical engineering graduates are employed in all industries.

Because the realm of mechanical engineering is so extensive and because it is the center from which many new engineering developments proceed, training must be broad and basic, providing the thorough grounding in fundamentals which an engineer requires in order to gain competence in any specialized field. In view of this, the curriculum in Mechanical Engineering includes ample

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* Students electing advanced military training will postpone history and economics courses until the senior year.

foundation courses in engineering, mathematics, physics, chemistry, drawing, and production methods. These are followed by courses in heat power, thermodynamics and fluid mechanics, mechanics and strength of materials, metallurgy, machine design, and industrial engineering. Throughout the eight semesters, about one-fifth of the course time is assigned to non-technical courses: English, speech, history, economics, government, psychology, and elective subjects. In the senior year, students have the opportunity to select courses from a large number of specialized courses which apply the principles previously learned or prepare the student for more advanced work on the graduate level.

For those who wish to specialize in industrial engineering, a separate option of courses is provided for the last two years. This option includes nearly the same basic training but specifies certain courses in accounting, production planning and control, motion and time study, and industrial relations in place of the free technical electives.

Students who are interested in design, research, development, and teaching and desire a more comprehensive background in mathematics, science, and fundamental engineering than can be obtained in the undergraduate program are encouraged to consider graduate study. Programs leading to the degrees of Master of Science in Mechanical Engineering and Doctor of Philosophy are offered.

A cooperative program under which students alternate periods of industrial employment with periods at the University is available to certain students in Mechanical Engineering. This program is described below.

Students who achieve a cumulative grade index of 4.8 or higher are given the opportunity to elect accelerated courses in the thermodynamics and machine design sequences, thus providing time for additional elective courses. Certain other special procedures are also available for superior students.

The curriculum in Mechanical Engineering is fully accredited by the Engineers' Council for Professional Development.

Mechanical Engineering Laboratories

Laboratory facilities in Mechanical Engineering for undergraduate instruction include the Mechanical Laboratory and the Fluid Mechanics Laboratory.

The **Mechanical Laboratory** is in a large wing of the Mechanical Engineering building and consists of a ground floor and two balconies serviced by a ten-ton crane. A wide variety of apparatus includes equipment for analysis of fuels and lubricants, for the measurement of temperature, pressure, flow, speed, and power, for the study of heat transfer, tests of fans, pumps, a uniflow steam engine, diesel and spark-ignition engines, turbines, and refrigeration plants. This equipment is supplemented by the modern university power plant which is used for student tests.

The **Fluid Mechanics Laboratory** contains subsonic and supersonic wind tunnels, a water-table, schlieren apparatus, capillary tube viscometers and other apparatus for determining flow characteristics in pipes and nozzles and around bodies of various shapes.

Specialized laboratories for advanced instruction of undergraduates and graduate study and research include a number of laboratories equipped with a variety of modern equipment and instrumentation. Extensive use is made of oscillographs, recording milli-ammeters, stroboscopes, high-speed motion pictures, electric strain gauges, various electronic aids, and special instruments for measuring temperature, flow, speed, acceleration, and sound.

The **Thermodynamics Laboratory** provides facilities for instruction and research in thermal conductivity, viscosity, specific heats, emissivity, absorptivity, and other physical properties. A steam generator capable of producing 3000 pounds of steam an hour at 3500 pounds per square inch and a constant temperature room approximately 20 by 30 feet in size are available.

The **Heat Transfer Laboratory** contains facilities for instruction and research in boiling, local heat transfer, free- and forced-convection heat transfer, heat transfer at high velocities and comfort effects.

The **Fluid Mechanics Laboratory** contains centrifugal blowers and tunnels for studies of boundary layer and turbulence in flow through diffusers, fan and compressor blades; interferometer, hot-wire anemometer, rotary displacement meter, ultrasonic instruments, vacuum pump, smoke tunnels, and a turbo-compressor rated at 14,000 cubic feet per minute for subsonic and supersonic flows.

The **Rocket, Jet Propulsion, and Gas Turbine Laboratories** are equipped to make performance and heat transfer studies of liquid-propellant rocket motors. The instrument and propellant supply systems allow tests with combustion pressures up to 2000 pounds per square inch. Extensive auxiliary facilities are available for studies on jet propulsion components and special problems.

The **Internal Combustion Engine Laboratory** comprises ten dynamometer rooms where modern diesel and spark-ignition engines are connected to electric dynamometers of the motor-generator and eddy-current types with as high as 2000 horsepower capacity at speeds up to 6000 revolutions per minute. Central engine-cooling, exhaust, and ventilating systems serve the sound-insulated rooms, and outside control panels enhance some of the installations. Special apparatus is available for the study of fuel rating, combustion, and fuel-injection systems.

The **Machine Design Laboratory** is equipped with solid foundations necessary for mounting equipment for dynamic and vibration study. Adequate instrumentation and specially constructed apparatus allow calibration, demonstration, and measurement of various types of vibration and dynamic forces. Special equipment for energy and friction measurements has been developed. A photoelastic polariscope, electric strain gauge apparatus and membrane analogy apparatus are used in strain-stress determinations.

Cooperative Program with Industry in Mechanical Engineering

A five-year cooperative education program is offered which enables a limited number of qualified students to obtain industrial experience with selected industries while completing the requirements for an engineering degree.

Qualified students, selected at the end of the freshman year, are divided into two groups. One group continues in school the first summer after the freshman year while the second group works in industry. At the beginning of the fall semester, the groups change places. This alteration continues until the beginning of the fifth academic year when both groups are back in school for the final year.

In order to qualify for the program, students will be required to have a scholastic index which places them in the upper half of the freshman engineering class at the end of their first year.

Students desiring to participate in the program should file an application with the Cooperative Education Program Coordinator by February 15 preceding the end of their freshman year. On the basis of the first semester's scholastic index, qualified students will be selected tentatively for the program. Upon completion of the year's work with the required index and upon acceptance as a cooperative program employee by a University-approved employer, students may formally enter upon the program.

Upon completion of the program, the students receive the regular engineering degree and a certificate indicating their completion of the cooperative education program with industry.

MECHANICAL ENGINEERING

(Total credits—155⅓ semester hours)

FRESHMAN YEAR

(See page 13)

SUMMER SESSION

The following four weeks' summer session must precede the sophomore year:

(2) G.E. 161 (Casting and Forging Design and Practice) —2 weeks.
(2) M.E. 280 (Mechanical Engineering Equipment Laboratory)—2 weeks.

GENERAL OPTION

SOPHOMORE YEAR

	Third Semester
(3)	*Spch. 114 (Principles of Speech) or Engl. 233 (Essay), Engl, 235 (Drama), Engl. 237 (Poetry), Engl. 238 (Fiction), or Engl. 250 (American Books)
(3)	Econ. 210 (Elementary Economics)
(4)	Math. 241 (Calculus I)
(5)	Phys. 240 (General Physics)
(2)	G.E. 222 (Descriptive Geometry)
(⅔)	M.E. 281 (Mechanical Engineering Lectures)
(2⅓ to 3)	*Military Training
(20 to 20⅔)	

	Fourth Semester
(5)	E.S. 204 (Statics and Kinetics)
(3)	**M.E. 230 (Elementary Heat Power)
(4)	Math. 242 (Calculus II)
(5)	Phys. 241 (General Physics)
(2⅓ to 3)	*Military Training
(19⅓ to 20)	

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* See notes on page 13.

JUNIOR YEAR

Fifth Semester

(4) E.S. 312 (Mechanics of Materials)
(3)**M.E. 360 (Mechanism)
(1) C.E. 331 (Testing Materials)
(3) Met. E. 345 (Elementary Metallurgy) or G.E. 365 (Industrial Organization and Management)
(3) M.E. 300 (Thermodynamics)
(2) M.E. 344 (Mechanical Engineering Laboratory)
(3) §Hist. 205 (U. S. in World Affairs) or Hist. 210 (Europe Since 1914)

(19)

Sixth Semester

(3⅔) M.E. 310 (Fluid Mechanics)
(3) Engl. 202 (Expository Writing)
(3) M.E. 366 (Dynamics of Machinery)
(3) §G.E. 365 (Industrial Organization and Management) or Met. E. 345 (Elementary Metallurgy)
(3) M.E. 301 (Thermodynamics)
(2) G.E. 345 (Machine Tool Laboratory)

(17⅔)

SENIOR YEAR

Seventh Semester

(3⅔) E.E. 315 (Direct Currents)
(2) M.E. 444 (Mechanical Engineering Laboratory)
(5) M.E. 470 (Machine Design)
(3) *Math. 421 or Technical Elective
(6) †Non-technical Electives

(19⅔)

Eighth Semester

(3⅔) E.E. 316 (Alternating Currents)
(3) M.E. 485 (Engineering Administration)
(3) §Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3) §Psy. 320 (Psychology for Engineers)
(6) ‡Technical Electives

(18⅔)

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* Differential Equations 421 or equivalent is required for enrollment in the Graduate School in Mechanical Engineering.

Students with a cumulative index of 4.5 or better who are interested in the more creative and technical phases of engineering such as research, design, and teaching are advised to follow a program leading to the degree of Master of Science in Mechanical Engineering or Doctor of Philosophy. It is recommended that such students select, in addition to Differential Equations 421, six hours of technical electives in accordance with their proposed field of graduate study as follows:

Thermodynamics and Heat Transmission: M.E. 500 and M.E. 505.
Fluid Mechanics: M.E. 500 and M.E. 510.
Internal Combustion Engines: M.E. 540 and M.E. 544.
Gas Turbines and Jet Propulsion: M.E. 500 and M.E. 510.
Machine Design: E.S. 521 and either M.E. 562 or E.S. 562.

† Students planning to be candidates for the degree of Doctor of Philosophy should schedule German 101 and 102 as their six hours of non-technical electives.

‡ With the approval of the head of the school, students may substitute a thesis for three credit hours of technical elective.

§ A student with an index of 4.8, or better, may, with the approval of his counselor.

a) take the accelerated sequence for heat power and thermodynamics and/ or machine design. ME 231 and 303 are equivalent to ME 230, 300, and 301. ME 363 and 463 are equivalent to ME 360, 366, and 470.

b) substitute another non-technical elective for any *one* of the following; Govt. 301 or 331, Hist. 205 or 210, Psy. 320.

c) substitute another course for GE 365.

INDUSTRIAL ENGINEERING OPTION

(Total credits—156⅓ semester hours)

Students who desire to specialize in the field of Industrial Engineering follow the curriculum of the General Option in the Freshman and Sophomore years.

JUNIOR YEAR*

Fifth Semester

(4)	E.S. 312 (Strength of Materials)
(3)	M.E. 360 (Mechanism)
(1)	C.E. 331 (Testing Materials)
(3)	G.E. 365 (Industrial Organization and Management)
(3)	Econ. 370 (Elements of Accounting) or G.E. 575 (Motion and Time Study)
(3)	‡Hist. 205 (U. S. in World Affairs) or Hist. 210 (Europe Since 1914)
(2)	G.E. 345 (Machine Tools)
(19)	

Sixth Semester

(3)	M.E. 371 (Machine Design)
(3)	Met. 345 (Elementary Metallurgy)
(3)	Engl. 202 (Expository Writing)
(3)	G.E. 575 (Motion and Time Study) or Econ. 370 (Elements of Accounting)
(3)	†G.E. 585 (Industrial Relations) or G.E. 578 (Process Design)
(2)	M.E. 344 (Mechanical Engineering Laboratory)
(3)	‡Psy. 320 (Psychology for Engineers)
(20)	

SENIOR YEAR*

Seventh Semester

(3⅔)	E.E. 315 (Direct Currents)
(3)	M.E. 300 (Thermodynamics)
(3⅔)	M.E. 310 (Fluid Mechanics)
(3)	† Econ. 570 (Cost Accounting)
(3)	G.E. 578 (Process Design) or †G.E. 585 (Industrial Relations)
(3)	Non-technical Elective
(19⅓)	

Eighth Semester

(3⅔)	E.E. 316 (Alternating Currents)
(3)	M.E. 301 (Thermodynamics)
(2)	M.E. 446 (Mechanical Engineering Laboratory)
(3)	G.E. 581 (Tool Design)
(3)	‡Govt. 301 (Elements of Democracy) or Govt. 331 (International Relations)
(3)	Non-technical Elective
(17⅔)	

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* Credit in Industrial Organization and Management 365, Elements of Accounting 370, Motion and Time Study 575, and Process Design 578 is prerequisite to admission to the Graduate School for studies leading to the degree of Master of Science in Industrial Engineering under the supervision of the Department of General Engineering.

‡ See fourth note on page 52.

† With the approval of the head of the school, students may substitute other courses in General Engineering for Econ. 570 and G.E. 585.

ENGINEERING LAW

(Total credits—113⅔ semester hours)

For students interested in an engineering background for law a combined curriculum leading to the degrees of B.S. in Engineering-Law and LL.B. has been arranged with Indiana University. This curriculum is of special interest to students who plan to enter the patent-law field, or upon a practice dealing extensively with radio, railway, other transportation and public utility, marine, or general engineering problems. The first three years are spent at Purdue University, where the following curriculum is required.

FRESHMAN YEAR

(See page 13)

SOPHOMORE YEAR

	Third Semester		Fourth Semester
(3)	Psy. 120 (General Psychology)	(5)	E.S. 204 (Statics and Kinetics)
(3)	Govt. 301 (Elements of Democracy)	(4)	Math. 242 (Calculus II)
(4)	Math. 241 (Calculus I)	(4⅓)	Phys. 231 (General Physics)
(4⅓)	Phys. 230 (General Physics)	(3)	Engl. 202 (Expository Writing)
(3)	*Spch. 114 (Principles of Speech) or Engl. 250 (American Books), Engl. 233 (Essays), Engl. 235 (Drama), Engl. 237 (Poetry) or Engl. 238 (Fiction)	(2⅓ to 3)	*Military Training
(2⅓ to 3)	*Military Training		
(19⅔ to 20⅓)		(18⅔ to 19⅓)	

JUNIOR YEAR

	Fifth Semester		Sixth Semester
(4)	E.S. 312 (Mechanics of Materials)	(3⅔)	E.E. 316 (Alternating Currents)
(3)	Econ. 210 (Economics)	(3)	Economics of Hist. 210 (Europe Since 1914) or Hist. 205 (U. S. in World Affairs)
(3⅔)	E.E. 315 (Direct Currents)	(3)	M.E. 307 (Elements of Thermodynamics)
(3)	M.E. 230 (Elementary Heat Power)	(3)	C.E. 341 (Hydraulics)
(3)	Govt. 510 (Political Parties and Politics)	(3)	†C.E. 373 (Fundamentals of Structural Design)
(3)	Technical Elective	(3)	†Elective
(19⅔)		(18⅔)	

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* See notes on page 13.

† C.E. 370 (Stresses) may be substituted for C.E. 373 (Fundamentals of Structural Design) and elective if the student is unable to schedule C.E. 373.

At the end of the sixth semester the student will transfer to the Indiana University School of Law and enter upon the regular professional curriculum there. Upon the successful completion of the three-year curriculum leading to the degree of LL.B at Indiana University, he will be entitled to the degree of Bachelor of Science in Engineering-Law from Purdue University. A student is expected to have a cumulative index of 4 or better on work done at Purdue University to be recommended for admission to the Indiana School of Law. A student may enter upon the professional work of the School of Law with an engineering degree and become a candidate for the degree of J.D. The requirements for this degree are set out in the bulletin of Indiana University.

GENERAL ENGINEERING

THE DEPARTMENT of General Engineering functions as a service department offering instruction in the fields of Industrial Engineering and Management, Manufacturing Process, including Machine Tool, Welding, Heat Treating, Foundry, and General Shop Laboratories, and Engineering Drawing. The degrees offered by this department are the M.S. and the M.S. in Industrial Engineering.

General Engineering Laboratories

The **General Shop Laboratory** is equipped to offer a wide range of shop experiences. The wood working area offers instruction in the use of power saws, spindle shapers, jointers, routers, mortisers, sanders and surfacers. The metal working area provides equipment for bench metal work, metal spinning, sheet metal processes, metal cutting and finishing. A third area offers electrical shop work in circuits, wiring, motor maintenance, fabrication and electronics.

The **Welding Laboratories** have facilities for demonstration, instruction, and practice in arc and oxy-acetylene welding. There are 16 arc welding stations, accommodating 32 students and 34 gas welding stations. The latter are served by a cascade battery of oxygen tanks and an acetylene generator. An aircraft welding laboratory accommodates 15 students at individual gas welding stations. Instruction in automatic arc, submerged melt, atomic hydrogen, inert arc, spot, seam, and projection welding, and metal spraying is offered in the new production welding laboratory.

The **Heat Treating Laboratory** has 16 stations, each with a pyrometer-controlled furnace, accommodating 32 students. A testing room is supplied with 8 Rockwell hardness testers for student use. Already equipped and under development is a production heat-treating laboratory equipped with gas carburizing, hydrizing, brazing, and tempering furnaces, all having automatic pyrometer controls, and induction hardening and magnaflux testing equipment.

The **Foundry and Metal Casting Laboratory** has a mechanized system of conveying sand to the storage bin, muller, and molding areas. Molds are made by two drag machines, two cope machines and five portable jolt squeezers. The core department is equipped with a core blower, core-making machines, a mixer and a core oven. The melting department consists of induction, direct- and indirect-arc melting furnaces, a gas-fired furnace and a cupola. Castings are cleaned by sand blast, shot blast, and tumbler.

The foundry is equipped with two control laboratories. The sand laboratory has a muller, core oven, gyratory riddle, permeability meter, moisture teller, universal sand strength machine, clay test and a Hitemp Dilatometer. The metal-control laboratory consists of apparatus for carbon and sulphur determination, fluidity and chill tests, a transverse tester, an optical pyrometer and a microscope.

The **Machine Tool Laboratory** covers approximately 16,000 square feet of floor space and includes over 165 different machine tools representative of most current industrial metal-cutting and forming practices. The equipment is grouped into two major sections:

(1) The basic metal-cutting tools include lathes, milling machines, band saws, shapers, drill presses, tappers and filers for general purpose work.

(2) The production tools include the more complex turret lathes, automatic screw machines, stamping and forming presses, cylindrical, surface, centerless and tool grinders, milling machines, gear-cutting machines, broaches, profiling and duplicating equipment and plastic-molding presses. Facilities for product assembly and inspection, materials handling and stock control complete the plant setup.

A separate **Gauge Laboratory** equipped with U. S. Navy property and housed in well lighted and air conditioned quarters includes an 80-inch measuring machine, comparators, tool maker's microscope, electric gauges, supermicrometer, lead-check equipment, small instruments and accessories.

MICHAEL GOLDEN ENGINEERING LABORATORIES

The **Motion and Time Study Laboratory** provides space and equipment for supervised practical problem activity for elementary and advanced classes in the area as well as research facilities for graduate students. The laboratory is equipped with its own shop, with power and hand tools, for jig and fixture construction. Adequate equipment for time study as well as a variety of motion picture cameras and regular and special-purpose motion picture projectors are available for routine activity. High speed electrical time-recording equipment, human metabolic measuring equipment and an automatic calculator together with a variety of basic components suitable for constructing required research apparatus gives the laboratory a wide range of activity. The University's extensive manufacturing process shops and cooperative industrial firms throughout the state give additional scope to the laboratory's field of investigation.

The **Drafting Rooms** which include four large well lighted rooms equipped with individual desks located in the Michael Golden Engineering Laboratories, one in Heavilon Hall and three in temporary quarters provide facilities for instruction in elementary and advanced engineering drawing and descriptive geometry.

DESCRIPTION OF COURSES

The courses listed on the following pages will, for the most part, be offered during the academic year 1955-56. In many cases the session in which a course will be offered is indicated thus: Sem. 1, Sem. 2, or SS (summer session). In some cases it is impossible to specify in advance whether or not a course will be offered in any given session. Information on this point may sometimes be obtained from the head of the department.

Aero—Aeronautical Engineering
A—Agriculture
AgE—Agricultural Engineering
AT—Air Transportation
Ch—Chemical Engineering
C—Civil Engineering
E—Electrical Engineering
Es—Engineering Mechanics
Engr—Engineering
F—Forestry
H—Home Economics
I—Industrial Education
L—Engineering Law
M—Mechanical Engineering
Met—Metallurgical Engineering
P—Pharmacy
S—Science, Education and Humanities

The prefix "el." or "op." indicates that the course is elective or optional and not required for the students specified.

1 through 49—Pre-college and deficiency courses

50 through 99—Non-degree courses (i.e., Agricultural short courses)

100 through 299—Lower division courses normally scheduled for freshmen and sophomores

300 through 499—Upper division courses normally scheduled for juniors and seniors

500 through 599—Dual level courses that may be scheduled by juniors, seniors, and by graduate students for graduate credit.

600 through 699—Graduate level courses restricted to graduate students.

AERONAUTICAL ENGINEERING

Professor DeGroff, Acting Head.

Professors: Bruhn, *Clauser, DeGroff, Liston, Lo, *Serbin, Shanks.
Associate Professors: Herrick, Stanley
Instructors: Hromas, Palmer, Schmitt
Graduate Teaching Assistants: Cooper, Costa, Decker, Kentzer, Schwegman
Graduate Assistant: Novak

UNDERGRADUATE LEVEL

Upper Division Courses

300. AVIATION LECTURES, Sem. 1 and 2. Class 1, cr. 0 (3 Aero)
Survey of the field of aviation. Professor Clauser and Staff.

310. AERODYNAMICS I. Sem. 1 and 2. Class 3, cr. 3 (6 Aero)
Must be preceded by M.E. 310.

Basic concepts and methods. Lift and drag, Types and properties of airfoils. The airplane wing. Aircraft propellers and propulsive jets. Introduction to aircraft performance.

320. WIND TUNNEL LABORATORY. Sem. 1 and 2. Lab. 3, cr. 1 (6 Aero)
Must be preceded or accompanied by A.E. 310,

Experimental aerodynamics to illustrate basic principles. Drag experiments; pressure distribution tests; airfoil tests; introduction to complete model testing.

340. AIRCRAFT VIBRATIONS. Sem. 1 and 2. Class 3, cr. 3 (6 Aero)
Must be preceded by Math. 421.

Fundamentals of vibrations with special references to aircraft components.
Professor Lo and Mr. Schmitt.

350. AIRCRAFT STRUCTURES I. Sem. 1 and 2. Class 3, cr. 3 (6 Aero)
Must be preceded by E.S. 312.

General loads and structural design criteria for aircraft; aircraft material; design of simple airplane units under tension, compression, bending, torsion and combined loading; fitting and joint analysis; unsymmetrical bending.

365. AIRCRAFT COMPONENTS. SS. 8 weeks Class 3, Lab. 3, cr. 2 (All Aero)
The general nomenclature and principle of operation of the various systems of the present day airplane.

381. AIRCRAFT POWERPLANTS. SS. 8 weeks Class 4, Lab. 12, cr. 4 (5 Aero)
Summer engine shops. Disassembly and study of the arrangement and functioning of the parts of various types of aircraft powerplants and their accessories.

410. AERODYNAMICS II. Sem. 1 and 2. Class 3, cr. 3 (7 Aero)
Must be preceded by A.E. 310.

Spanwise lift distribution of airplane wings. Application to stability derivatives. Control surface analysis. Introduction to stability and control.

420. AERODYNAMIC DESIGN OF AIRCRAFT.
Sem. 1. Class 1, Lab. 2, cr. 2 (el. 7, 8 Aero)
Must be preceded or accompanied by A.E. 410.

Preliminary aerodynamic design of an airplane based on specification requirements.
Professor Serbin.

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* On leave of absence 1954-55.

421. FLIGHT TESTING AND FLIGHT INSTRUMENTATION.
Sem. 2. Class 2, Lab. 3, cr. 3 (el. 8 Aero)
Must be preceded or accompanied by A.E. 410.

Instrumentation of the airplane and tests on it. Theory of flight test procedures. Actual flight test operations; reduction of data and report writing.

450. AIRCRAFT STRUCTURES II. Sem. 1 and 2. Class 3, cr. 3 (7 Aero)
Must be preceded by A.E. 350.

Deflections; shear flow in thin walled cellular sections; buckling and ultimate strengths of sheet and sheet-stringer units; semi-tension field beams.

460. AIRCRAFT LOADS. Sem. 1. Class 3, cr. 3 (el. Aero)
Must be preceded by A.E. 310 and 350.

Calculation of flight, landing, and take-off loads on aircraft structures.

465. AIRCRAFT STRUCTURES LABORATORY.
Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (8 Aero)
Must be preceded by A.E. 450 and preceded or accompanied by A.E. 340.

Proof and ultimate strength tests of airplane units and assemblies. Dynamic tests. Emphasis on test report writing. Mr. Schmitt.

466. AIRCRAFT MATERIALS AND TESTING. Sem. 1. Class 1, Lab. 3, cr. 2

Advanced strength of materials, stress concentration, fatigue, impact, creep; application to aircraft materials and design; experimental methods of strength testing and stress analysis.

471. AIRCRAFT POWERPLANTS I.
Sem. 1 and 2. Class 3, cr. 3 (7 Aero, el. 7M)
Must be preceded by M.E. 307, A.E. 310, and A.E. 381.

Basic principles of all types of aircraft powerplants, fuels and accessories; performance characteristics, advantages, limitations, and applications.

481. AIRCRAFT POWERPLANT LABORATORY.
Sem. 1 and 2. Lab. 3, cr. 1 (7 Aero, el. 7M)
Must be preceded or accompanied by A.E. 471 or M.E. 540.

Experimental study of testing techniques and methods used in determining the characteristics of aircraft powerplants and components.

482. AIRCRAFT POWERPLANT LABORATORY I.
Sem. 1 and 2. Class 1, Lab. 3, cr. 2 (7 Aero)
Must be preceded or accompanied by A.E. 471 or M.E. 540.

Experimental studies of testing techniques, methods, and procedures for determining and evaluating the characteristics of aircraft powerplants and components.

490. SPECIAL PROBLEMS IN AERONAUTICAL ENGINEERING. Sem. 1 and 2.
Hours and credits to be arranged. Staff.

498. AERONAUTICAL ENGINEERING SEMINAR. Sem. 2. Class 1, cr. 1

499. RESEARCH IN AERONAUTICAL ENGINEERING. Sem. 1 and 2
Hours and credit to be arranged.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

501. AIRCRAFT CONTROL EQUIPMENT.
Sem. 1 and 2. Class 3, cr. 3 (el. 8 Aero)
Must be preceded by E.E. 316, A.E. 310 and A.E. 471.

Fundamental control system theory. Types of manual and automatic control systems such as turbo-supercharger controls, automatic pilot, etc. Professor Stanley.

510. THEORY OF AIRFOIL SECTIONS. Sem. 1. Class 3, cr. 3 (el. 7, 8 Aero)
Must be preceded by A.E. 310 or M.E. 510.

Basis of modern airfoil theory. Rational design of airfoil sections.
Professor Serbin.

520. STABILITY AND CONTROL. Sem. 2. Class 3, cr. 3 (el. 8 Aero)
Must be preceded by A.E. 410 or equivalent.

Stability derivatives of wings and bodies. Dynamic stability. Spins. Modern airplane requirements. Professor Serbin.

522. AERODYNAMICS OF HELICOPTERS. Sem. 2, Class 3, cr. 3
Must be preceded by A.E. 410.

Theory of rotors; helicopter performance and stability.

525. INTERNAL AERODYNAMICS. Sem. 1. Class 3, cr. 3 (7 Aero)
Must be preceded by A.E. 310 and A.E. 471 or M.E. 540.

Aerodynamic aspects of the flow of combustion and cooling air related to thermodynamic processes and their effect upon the design and installation of aircraft powerplant components and upon aircraft performance.

530. AEROELASTICITY. Sem. 1 and 2. Class 3, cr. 3 (el. 8 Aero)
Must be preceded by A.E. 310 and A.E. 340.

Aerodynamic loads of a flexible surface. Divergence, control effectiveness and reversal. Introduction to flutter theory. Professor Lo.

540. AIRCRAFT VIBRATIONS AND DYNAMICS.
Sem. 2. Class 3, cr. 3 (el. 8 Aero)
Must be preceded by A.E. 340.

More advanced topics in aircraft vibrations with an introduction to dynamic analysis. Professor Lo.

550. AIRCRAFT STRUCTURES III. Sem. 1 and 2. Class 3, cr. 3 (el. 8 Aero)
Must be preceded by A.E. 450.

Analysis of statically indeterminate structures common to aircraft such as trusses, beams, frames, and rings, by several different methods.

551. ADVANCED AIRCRAFT STRUCTURES I.
Sem. 2. Class 3, cr. 3
Must be preceded by Math. 421, A.E. 450 or equivalent.

Development of elastic theory from a more theoretical consideration, with emphasis on energy methods. Application of theory to airframe problems. Mr. Schmitt.

561. AIRCRAFT STRUCTURAL DESIGN I.
Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el. 8 Aero)
Must be preceded by A.E. 450.

Analysis and design of various types of stressed-skin wing and fuselage construction.

571. AIRCRAFT POWERPLANTS II. Sem. 2. Class 3, cr. 3 (8 Aero)
Must be preceded by A.E. 471 or M.E. 540 and A.E. 481 or A.E. 482.

Continuation of A.E. 471 with emphasis on the overall design requirements of all types of aircraft powerplants.

577. AIRCRAFT POWERPLANT INSTALLATION.
Sem. 2. Class 2, Lab. 3, cr. 3 (el. 8 Aero)

Engineering study and analysis of engine mounts, cooling systems, air and fuel systems, lubrication systems, ignition systems, instrumentation and controls.

582. AIRCRAFT POWERPLANT LABORATORY II.
Sem. 2. Class 1, Lab. 3, cr. 2 (8 Aero)
Must be preceded or accompanied by A.E. 571 or M.E. 551.

Continuation of A.E. 482 with emphasis on performance evaluation and appraisal in terms of aircraft requirements.

586. AIRCRAFT POWERPLANT DESIGN.
Sem. 1 and 2. Class 2, Lab. 6, cr. 4 (8 Aero, el. 8M)
Must be preceded by M.E. 371 or 470 and A.E. 471 or M.E. 540.

Selection of desired characteristics, analysis of loads and stresses, selection of suitable materials, design and specification of parts for an aircraft or other type of high performance powerplant.

590. PROJECTS IN AERONAUTICAL ENGINEERING. Sem. 1 and 2. cr. 1-6

GRADUATE LEVEL

610. AERODYNAMICS OF PERFECT FLUIDS I. Sem. 2. Class 3, cr. 3
Must be preceded by A.E. 510, Math. 523 or equivalent, and preceded or accompanied by Math. 525 or Math. 630.

Application of principles of conservation of mass, momentum, and energy to three-dimensional fluid flows; Helmholtz vortex theorems; significant flow patterns; motion of solid bodies through fluids; application of complex variables; thin airfoil theory.

611. AERODYNAMICS OF PERFECT FLUIDS II. Sem. 1. Class 3, cr. 3
Must be preceded by A.E. 610.

Continuation of A.E. 610. Flow about arbitrary airfoils; design of airfoils to specified pressure distribution; free stream line; discontinuous motions; acceleration potential; non-uniform and curvilinear motion.

612. AERODYNAMICS OF REAL FLUIDS. Sem. 2. Class 3, cr. 3
Must be preceded by A.E. 510 and Math. 523.

One-dimensional, incompressible viscous fluid flows; viscosity and heat conduction from the kinetic theory viewpoint; stress and strain in a real fluid; the Navier-Stokes equations; Prandtl boundary layer theory; diabatic flow.

614. AERODYNAMICS OF COMPRESSIBLE FLUIDS. Sem. 1. Class 3, cr. 3
Must be preceded by A.E. 610.

Isentropic flow of compressible fluids and hodograph methods for subsonic and mixed flows; shock phenomena; rigorous development of the method of characteristics.

615. AERODYNAMIC THEORY OF THE FINITE WING.
Sem. 1. Class 3, cr. 3
Must be preceded by A.E. 610.

Theory of finite wings in subsonic and supersonic flow based on generalized potential theory using methods of series and singularities.

618. TRANSONIC AND SUPERSONIC AERODYNAMICS.
Sem. 2. Class 3, cr. 3
Must be preceded by A.E. 614.

Continuation of Aero. E. 614. Theory of compressible boundary layer; heat transfer at supersonic speeds; methods of characteristics; linearized wing theory for both steady and non-steady flows.
Professor Shanks.

620. ANALYSIS OF DRAG. Sem. 1 or 2. Class 3, cr. 3
Must be preceded by A.E. 510.

Theory of the boundary layer in laminar and turbulent flow. The drag of airfoils. Statistical turbulence.
Professor Serbin.

630. AIRCRAFT DYNAMIC ANALYSIS. Sem. 1. Class 3, cr. 3
Must be preceded by A.E. 310, 340 and 450.

Analysis of transient stresses in aircraft structures under dynamic loading conditions such as landing, gusts, tail buffeting.
Professor Lo.

631. AIRCRAFT FLUTTER. Sem. 2. Class 3, cr. 3
Must be preceded by A.E. 530.

Advanced problems in the field of aircraft flutter.
Professor Lo.

640. ADVANCED AIRCRAFT VIBRATIONS. Sem. 2. Class 3, cr. 3
Must be preceded by A.E. 340 or equivalent.

Vibrations of systems with non-linear characteristics, systems with many degrees of freedom; vibrations of shafts and elastic bodies; applications to aircraft structures and aircraft powerplants.
Professor Lo.

651. ADVANCED AIRCRAFT STRUCTURES II. Sem. 2. Class 3, cr. 3
Must be preceded by A.E. 551.

Continuation of course A.E. 551.

652. THEORY OF PLASTICITY IN AIRCRAFT STRUCTURES.
Sem. 2. Class 2, cr. 2
Must be preceded by A.E. 450 and Math. 421.

Influence of creep, temperature and fatigue on design; analysis and design of aircraft structures in the inelastic zone.

661. AIRCRAFT STRUCTURAL DESIGN II. Class 2, Lab. 3, cr. 3
Must be preceded by A.E. 561.

Continuation of course A.E. 561 with introduction to swept wing and thick wing skin structural analysis and design.

665. ADVANCED AIRCRAFT STRUCTURES LABORATORY.
Sem. 1 or 2. Lab. 6, cr. 2
Must be preceded by A.E. 465.

Advanced static and dynamic testing of airplane structural units.
Professor Herrick.

676. ADVANCED AIRCRAFT ENGINE DESIGN.
Sem. 1 or 2. Class 1, Lab. 6, cr. 3
Must be preceded by A.E. 586 or equivalent.

Continuation of A.E. 586, including design of special engine features.
Professor Liston.

690. ADVANCED AERONAUTICAL ENGINEERING PROJECTS. Sem. 1 and 2.
Hours and credit to be arranged. Staff.

691. AERODYNAMICS SEMINAR. Sem. 1 and 2. cr. 1-6

695. AIRCRAFT STRUCTURE SEMINAR. Sem. 1 and 2. cr. 1-6

697. INTERNAL COMBUSTION ENGINE SEMINAR.
Sem. 1 and 2. cr. 2 to 6

Conferences on selected subjects. Literature and presentation of oral and written reports.

698. RESEARCH M.S. THESIS. Sem. 1 and 2.

699. RESEARCH Ph.D. THESIS. Sem. 1 and 2.

AIR TRANSPORTATION

Professor DeGroff, Acting Head.

Professor: Bruhn.
Associate Professors: Fowler, Stanley.
Assistant Professors: Briggs, Cargnino.
Instructor: Basinger.
Associate: Webster.

UNDERGRADUATE LEVEL

Lower Division Courses

211. PRINCIPLES OF FLIGHT. Sem. 2. Class 3, cr. 3
Must be preceded by Math. 142 and Phys. 220.

Elementary principles of airplane performance; the economics of airplane operation.

226. GENERAL METEOROLOGY. Sem. 1 and 2. Class 3, cr. 3

Must be preceded by 3 hours college mathematics.

A practical treatment of the atmospheric phenomena which make up our everyday weather.

230. AIR TRANSPORTATION LECTURES.

Sem. 1 and 2. Class 1, cr. 0 (3 AT)

A survey of the field, including airport managemeunt, fixed base operations, personal aircraft, professional piloting and air age education.

Professor Fowler and Staff.

250. AIRCRAFT POWERPLANTS. Sem. 2. Class 3, cr. 3 (4 AT)

Elementary engine theory; nomenclature and functional analysis of aircraft power plant; types of engines; ignition, fuel, lubrication, superchargers, instruments, accessories, propellors.

Professor Cargnino.

256. AIRCRAFT ENGINES. Sem. 2. Class 3, Lab. 6, cr. 5

Fundamental principles of aircraft engines including practical application and operation.

257. AIRCRAFT ENGINE ACCESSORIES. Sem. 2. Class 3, Lab. 6, cr. 5

Fundamental principles of propellers, fuel controls, ignition and starter systems including practical application and operation.

260. AIRFRAME COMPONENTS AND INSTALLATIONS.

Sem. 2. Class 3, cr. 3 (4, 5 AT)

Nomenclature, purpose, kind of materials used, general construction, and elementary principles of operation of the components and installations of the airframe.

Professor Briggs.

UNDERGRADUATE LEVEL

Upper Division Courses

325. AERONAUTICAL METEOROLOGY.

Sem. 2. Class 2, Lab. 3, cr. 3 (6 AT)

Must be preceded by A.T. 226.

General circulation, adiabatic diagrams, air mass analysis, frontal weather, map making, forecasting, special problems of aviation, climatology, aircraft dispatching.

Professor Briggs.

355. AIRCRAFT POWERPLANT MAINTENANCE.

Sem. 1 and 2. Class 4, Lab. 3, cr. 5

Must be preceded by A.T. 255.

Maintenance of airworthy powerplants; accessories and systems pertaining thereto.

Mr. Basinger.

356. TURBO JET ENGINE SYSTEMS. Class 3, cr. 3 (el. AT)

Must be preceded by Physics 221 or equivalent.

Fundamental principles of jet powerplants, induction and exhaust systems, fuel systems, lubrication systems, ignition and starting systems, augmentation methods, etc.

357. AIRCRAFT INSTRUMENTS. Class 3, cr. 3 (el. AT)

Must be preceded by Physics 221 or equivalent.

Theory, operation and installation of instruments used in aircraft. This includes powerplant and flight instruments.

358. AIRCRAFT ELECTRICAL SYSTEMS. Class 3, cr. 3 (el. AT)
Must be preceded by Physics 221 or equivalent.

A detailed study of electrical applications pertaining to modern aircraft, including automatic and electronic control systems.

361. AIRCRAFT MAINTENANCE. Sem. 1 and 2. Class 2, Lab. 6, cr. 4
Must be preceded by A.T. 362 and G.E. 336 and 347.

Maintenance of airworthy aircraft, accessories and systems pertaining thereto.
Mr. Basinger.

362. AIRCRAFT SYSTEMS AND INSTALLATION. Sem. 1. Class 4, Lab. 5, cr. 5

Fundamental principles of the following systems: hydraulic electrical, anti-icing, heating and ventilation, instruments, etc., including practical application and operation.

365. ELEMENTARY AIRCRAFT STRUCTURES. Sem. 2. Class 3, cr. 3 (8 AT)
Must be preceded by E.S. 210.

Physical properties of aircraft materials; airplant load factors; design of simple aircraft units in tension, compression, and shear; joints and splices; C.A.A. repair regulations.
Professor Bruhn.

366. ELEMENTARY AIRCRAFT STRUCTURES. Class 3, cr. 3 (el. AT)
Must be preceded by A.T. 365.

A continuation of course A.T. 365. Introduction to strength design of major airplane units such as the wing, fuselage, and surface units. Repairs and maintenance of such structures.

370. AIR TRAFFIC PROCEDURES AND PRACTICES.
Sem. 1 and 2. Class 1, Lab. 3, cr. 2 (el. AT)
Students must have sophomore standing and permission of the instructor.

Traffic procedures of various airlines; laboratory experience in reservations, ticketing, and operations.
Professor Fowler.

470. AIRLINE MANAGEMENT AND OPERATION.
Sem. 1 and 2. Class 3, cr. 3 (6, 8 AT)
Administrative and operational problems of the airline. Professor Fowler.

471. AIR TRAFFIC AND CARGO. Sem. 1 and 2. Class 3, cr. 3 (8 AT)
Passenger and cargo handling and sales. Professor Fowler.

480. AIRPORT OPERATION AND CONTROL.
Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (7 AT)
Problems of airport management; traffic control problems. Mr. Webster.

492. SPECIAL PROBLEMS IN AIR TRANSPORTATION.
Sem. 1 and 2. cr. 1 to 3 (el. AT)
Hours and credits to be arranged. Staff.

AGRICULTURAL ENGINEERING*

Professor Spencer, Acting Head.

Professor: Spencer.
Associate Professor: Dale.
Assistant Professors: Hansen, Isaacs, Liljedahl.
Instructor: Klinge.

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* The Agricultural Engineering staff members are listed in the catalog of the School of Agriculture. A complete list of Agricultural Engineering courses appears in the catalog for the School of Agriculture. Only those courses which are required in the Agricultural Engineering curriculum are listed in this catalog.

UNDERGRADUATE LEVEL

Lower Division Courses

205. AGRICULTURAL ENGINEERING PROBLEMS. Class 1, cr. 1 (3 AgE)

Lectures and recitations to acquaint the student with the fields in agricultural engineering. Problems to illustrate the requirements, ability, and training best suited for each.
Professor Spencer.

235. AGRICULTURAL MACHINERY. Class 2, Lab. 3, cr. 3 (4 AgE)

Must be preceded by Phys. 240.

Functional requirements; elements of machine construction, performance and applications of machines in agricultural operations; selection, capacity, economy, and operation of agricultural machinery.
Professor Liljedahl.

UNDERGRADUATE LEVEL

Upper Division Courses

325. SOIL AND WATER. Class 2, Lab. 3, cr. 3 (5 AgE)

Must be preceded by C.E. 100 and accompanied by Agron. 260.

The application of terraces, drains, and dams to modern farming. Soil and moisture control by mechanical methods. Factors affecting run off; erosion control structures.

355. FARM AND HOME UTILITIES. Class 2, Lab. 3, cr. 3 (6 AgE)

Must be preceded by E.E. 315 and accompanied by E.E. 316.

Electric service, water supply, sewage disposal, heating, lighting and refrigeration.
Professor Hansen.

445. AGRICULTURAL POWER. Class 2, Lab. 3, cr. 3 (7 AgE)

Must be preceded by E.S. 204, 313 and M.E. 230, 307.

The mechanics of tractor power application. Thermodynamics principles and construction of the internal combustion engine and its fuels, lubricants, ignition, and carburetion. Problems of operation, economy, and application of agricultural power units.
Professor Liljedahl.

455. FARM PROCESSING. Class 2, Lab. 3, cr. 3 (8 AgE)

Must be preceded by Ag.E. 475 and M.E. 310.

Principles and applications of drying of farm products; including grain and hays; separation of seeds; grinding and mixing of feeds; blanching and dehydration of vegetables; dairy processing; processing by freezing.
Professor Isaacs.

475. FARM STRUCTURES. Class 2, Lab. 3, cr. 3 (7 AgE)

Must be preceded or accompanied by E.S. 312 or 313, M.E. 307, Agron. 105 and An. Husb. 301.

Analysis of functional requirements for various types of farm structures. Planning procedures, economic consideration, materials of construction and their use. Design of elements of farm structures.
Professor Dale.

496. AGRICULTURAL ENGINEERING SEMINAR. Class 1, cr. 1 (8 AgE)

Formal reports and discussions.
Professor Spencer.

498. SPECIAL PROBLEMS. SS. Sem. 1 and 2. cr. 3 (7, 8 AgE)

Open primarily to qualified seniors who desire to study special problems in Agricultural Engineering not covered in regular course work.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

526. DRAINAGE, EROSION, AND FLOOD CONTROL. Class 2, Lab. 3, cr. 3 (el. 8 AgE)

Must be preceded by Ag.E. 325.

Hydrologic and hydraulic design of flood control and erosion control structures. Theory and practice of agricultural drainage. Drainage, flood control, and erosion control as group enterprises.

536. FARM IMPLEMENTS. Class 2, Lab. 3, cr. 3 (el. 8 AgE)

Must be preceded by Ag.E. 235, 445 and M.E. 462.

Analysis of power and machinery requirements for specified farming operations. Special consideration of power take-off, mounted and self-propelled equipment. Field and laboratory tests of field and power units. Professor Liljedahl.

576. AGRICULTURAL STRUCTURES DESIGN. Class 1, Lab. 6, cr. 3 (el. 8 AgE)

Must be preceded by Ag.E. 475.

Load computation, stress analysis, and structural design for farm buildings. Functional planning, structural design, and preparation of working drawings for a typical building. Professor Dale.

596. AGRICULTURAL ENGINEERING APPLICATIONS. Class 2, Lab. 3, cr. 3 (el. 8 AgE)

Must be preceded by Ag.E. 235, 445, 355, 475 and 325.

Individual problems involving investigation, discussion, and design in the fields of specialization.

GRADUATE LEVEL

627. THEORY OF WATER MANAGEMENT. Class 3, cr. 3

Must be preceded by Math. 421.

Analytical consideration of soil moisture, ground water flow, surface runoff, and sedimentation in relation to agricultural lands.

637. FUNCTIONAL ANALYSIS OF FARM MACHINES. Class 2, Lab. 3, cr. 3

Must be preceded by M.E. 567.

Application of engineering fundamentals and techniques for determining the load and power requirements in machines performing selected processes and operation. Professor Liljedahl.

677. FARM STRUCTURES PROBLEMS. Class 3, cr. 3

Must be preceded by M.E. 505.

Analytical consideration of ventilation of animal shelters, moisture condensation in walls, solar heat transmission through roofs, and design of farm storage structures. Professor Dale.

695. TOPICAL RESEARCH PROBLEMS IN AGRICULTURAL ENGINEERING. Class 3, cr. 3

Training in investigation and research in agricultural engineering. Staff.

697. SEMINAR. Sem. 1 and 2 Class 1, cr. 1

Discussion of research problems, methods, procedure, and reports. Staff.

698. RESEARCH IN AGRICULTURAL ENGINEERING (M.S. THESIS)

Farm equipment and all types of farm power; land reclamation. Staff.

The following required subjects in the curriculum of Agricultural Engineering are offered by the departments of Agriculture (Agr), Agricultural Economics (AgEc), Agronomy (Agron), Animal Husbandry (AH), Botany and Plant Pathology (Btny), Dairy (Dy), and Horticulture (Hort) in the School of Agriculture.

UNDERGRADUATE LEVEL
Lower Division Courses

101. (Agr.) AGRICULTURAL LECTURES.
Sem. 1. Class 1, cr. 0 (1 A, 1 F, 3 AgE)

To acquaint new students in agriculture with the important problems and opportunities in the various fields of agriculture. Professor Pfendler and Staff.

103. (Btny.) FUNDAMENTALS OF PLANT SCIENCE.
Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (4 AgE, el. 1 or 2 A)

An introduction to plant science; the development, function, reproduction and relationship of plants. Designed to provide a broad understanding of fundamental plant science. Professors Cummins, Gries, Lefforge, Postlethwait, Stearns.

105. (Agron.) CROP PRODUCTION.
Class 2, Lab. 2, cr. 3 (3 AgE, el. 1 or 2 A)

Fundamental principles in crop production, distribution, rotations, soil relations; grain and forage crops, adaptation, characteristics, varieties, harvesting, storage, and marketing.
Mr. Hilst.

260. (Agron.) SOILS. Class 2, Lab. 2, cr. 3 (5 AgE, el. 3 A)
Must be preceded by Chem. 101, 102, or 111, 112, or 117, 118.

Origin, classification, and physical properties of soils as related to tillage, drainage, moisture supply, temperature, aeration, and chemical and biological activities within the soil. Professor Seaton and Mr. Bertrand.

UNDERGRADUATE LEVEL
Upper Division Courses

301. (A.H.) LIVESTOCK MANAGEMENT. Class 2, Lab. 2, cr. 3 (7 AgE)

For students specializing in Agricultural Engineering, Feeding, housing, and management of meat animals.
Professor Sharp.

318. (Hort.) GENERAL HORTICULTURE.
Sem. 1 or 2. Class 3, cr. 3 (8 AgE, el. 5 to 8 A)

Of special interest to students who want one 3-credit course in the various fields of horticulture. Not to be taken by students who have credit in Hort. 151, 171, 207 or 308.
Professor Lommel.

320. MARKETING FARM PRODUCTS.
Sem. 1 and 2. Class 3, cr. 3 (6 AgE, 5 or 6 A)

Types of products; types of markets; middlemen and their services; price-determining factors; market information; surplus production; governmental agencies; cooperative marketing.
Professor Kohls.

408. (Dy.) MILK PRODUCTION. Class 2, Lab. 2, cr. 3 (8 AgE, el. 5 to 8 A)
For students who have not taken Dy. 101.

Specific problems pertaining to milk production. Information believed essential for the student to gain a concept of breeding, feeding and management of dairy cattle. At least one field trip will be taken. Professor Hill and Mr. Hindrey.

410. (AgEc) FARM ORGANIZATION.
Sem. 1. Class 2, Lab. 2, cr. 3 (6 AgE, el. 5 or 7 A)

Economic factors controlling success in farming; types of farming, business analysis, adjustment in organization to meet changing economic conditions; organization and management of successful farms.
Professor Thomas.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

501. (AgEc) AGRICULTURAL STATISTICS.
Sem. 1. Class 2, Lab. 2, cr. 3 (7 AgE, el. 5 A)

Statistical methods and their application; frequency distributions, averages, measurements of variation, their reliability, trend, and linear correlation; classification, tabulation, and graphic representation. Professor Kahrberg.

CHEMICAL AND METALLURGICAL ENGINEERING AND GEOLOGY

Professor Comings in charge.

CHEMICAL ENGINEERING

Professors: Comings, Morgen, Rushton, Sherman, *Shreve, Smith.
Associate Professors: Bennett, Doody, Myers, Sesonske, Tucker.
Assistant Professors: Emery, Hite, Tierney, Van Ness, Woods.
Instructor: Pauls.
Graduate Teaching Assistants: Bunnell, Brouillette, Farell, Mehta, Mishaan, Sheng, Tartaron, and Wortman.
Engineering Experiment Station: Research Associates: †Golding and Higa.
Research Assistant: R. Bailey.
Graduate Assistants: Abdul-Karim, Abraham, Bringer, Collins, Harding, Humphrey, Klar, Kurihara, Lee, Leng, McFedries, McLain, Miller and Smith.

METALLURGICAL ENGINEERING

Professors: Schuhmann, *Hanley.
Associate Professors: Evers, Guy, Parlee.
Assistant Professors: Grace, Hughel.
Instructor: Morris
Graduate Teaching Assistants: Hepworth, Schadler.
Graduate Assistants: Hornaday and Phelps.

GEOLOGY

Assistant Professors: Lounsbury and Melhorn.

CHEMICAL ENGINEERING

UNDERGRADUATE LEVEL

Lower Division Courses

201. CHEMICAL ENGINEERING CALCULATIONS.
SS. Sem. 1. Class 2, Lab. 2, cr. 3 (3 Ch)

Must be preceded by Chem. 101-102 or equivalent and accompanied or preceded by Math. 241 and Phys. 230.

Chemical engineering calculations with emphasis on energy and material balances as applied to industrial processes. Several lectures by staff members and guests are included to acquaint the student with various aspects of the chemical engineering profession. Professors Hite, Morgen, Myers, Tierney and Tucker.

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* Formosa—Purdue Engineering Project.

† Special lecturer for Chemistry and Engineering of High Polymers.

202. ELEMENTARY CHEMICAL ENGINEERING THERMODYNAMICS.
Sem. 2, SS. Class 2, Lab. 3, cr. 3 (4 Ch)

Must be preceded by Ch.E. 201.

Thermodynamic concepts of heat, work, system, process, and conservation of energy applied to batch and flow processes; properties of gases.

Professors Emery, Hite, Morgen, Tierney and Sesonske.

230. CHEMISTRY OF ENGINEERING MATERIALS. Class 3, cr. 3 (el.)

Available for students of any classification not enrolled in chemical engineering.

Must be preceded by Chem. 101 or equivalent. Staff.

UNDERGRADUATE LEVEL

Upper Division Courses

390. INSPECTION TRIPS AND PROFESSIONAL GUIDANCE.
Sem. 2. cr. 1/3 (6 Ch)

Required inspection trips to selected chemical process industries and lecture discussions to acquaint the prospective graduate with the practice of chemical engineering. A transportation deposit is collected at the beginning of the term—unused portion will be refunded. Professors Hite and Woods.

410. CHEMICAL ENGINEERING THERMODYNAMICS.
Sem. 1 and 2. Class 3, cr. 3 (6, 7 Ch)

Must be preceded by Ch.E. 202, Math. 242, Phys. 231 or equivalent.

Review of the fundamentals of thermodynamics, second law, properties of fluids, phase and chemical equilibrium, and applications to chemical engineering.

Professors Bennett, Sesonske, Smith and Van Ness.

411. CHEMICAL ENGINEERING PROBLEMS.
Lab. 3 to Class 1, Lab. 9, cr. 1 to 4 (el.)

Prerequisites dependent upon nature of problem. Staff.

443. FLUID FLOW AND HEAT TRANSFER. Sem. 1. Class 2, cr. 2 (7 Met)

Professor Emery.

490. INSPECTION TRIPS AND PROFESSIONAL GUIDANCE.
Sem. 1. cr. 1/3 (7 Ch)

Required inspection trips to selected chemical process industries and lecture discussions to acquaint the prospective graduate with the practice of chemical engineering. A transportation deposit is collected at the beginning of the term—unused portion will be refunded.

Professor Hite.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

510. INTERMEDIATE CHEMICAL ENGINEERING THERMODYNAMICS.
Sem. 2. Class 3, cr. 3

Must be preceded by Ch.E. 410 or equivalent.

Chemical engineering thermodynamics with emphasis on chemical and phase equilibria.

Professor Van Ness.

526. CHEMICAL REACTOR DESIGN. Sem. 2. Class 3, cr. 3

Must be preceded by Ch.E. 537 and Chem. 574 or equivalent.

The reaction rates, equilibria, heat effects, and use of catalysts in reactions of industrial importance. Simple rate equations are applied to the design of industrial chemical reactors.

Professor Woods.

527. ADVANCED CHEMICAL ENGINEERING CALCULATIONS.
Sem. 1. Class 3, cr. 3

Must be preceded by Ch.E. 538 or equivalent.

Applications of differential and integral calculus in the design of chemical engineering equipment and processes. Professor Myers.

528. CHEMICAL PROCESS INDUSTRIES. Sem. 1. Class 3, cr. 3 (7 Ch, el.)

Must be preceded or accompanied by Chem. 551, 574 and Ch.E. 537.

Applications of unit operations, unit processes, and flow sheets.
Professors Comings, Hite and Woods.

529. CHEMICAL PROCESS INDUSTRIES. Sem. 2. Class 3, cr. 3 (8 Ch, el.)

Must be preceded by Ch.E. 538.

Continuation of Ch.E. 528 with A.I.Ch.E. Contest Problem.
Professors Doody, Hite and Woods.

530. ADVANCED UNIT OPERATIONS LABORATORY.
Sem. 1 and 2. Lab. 3 to Lab. 9, cr. 1 to 3

Must be preceded by Ch.E. 537 and 538 or equivalent.

Advanced laboratory technique, special emphasis on design. Staff.

537. UNIT OPERATIONS. Sem. 1 and 2. Class 3, cr. 3 (5 Ch, el.)

Must be preceded by Ch.E. 201 and preceded or accompanied by Ch.E. 202.

Quantitative problems in the operation of chemical process equipment, including fluid flow, heat transfer, filtration, and evaporation.
Professors Bennett, Emery, Sesonske, Van Ness and Woods.

538. UNIT OPERATIONS. Sem. 1 and 2. Class 3, cr. 3 (6 Ch, el.)

Must be preceded by Ch.E. 537.

Continuation of Ch.E. 537, distillation, gas absorption, drying and liquid extraction.
Professors Bennett, Emery, Myers and Tierney.

539. UNIT OPERATIONS. Sem. 1. SS. Lab. 6, cr. 2

Must be preceded by Ch.E. 537.

Quantitative study of fluid flow, heat transfer, evaporation, etc., comparing the operation of actual equipment with theory. Special consideration of problems in design and the writing of reports. Professor Tucker.

540. UNIT OPERATIONS. Sem. 2. SS. Lab. 6, cr. 2

Must be preceded by Ch.E. 538.

Continuation of Ch.E. 539, covering diffusional operations such as distillation and absorption. Professor Tucker.

541. INDUSTRIAL ELECTROCHEMISTRY. Class 3, cr. 3 (el.)

Must be preceded by Chem. 552 and 574 or equivalent. Professor Grace.

542. CHEMISTRY AND ENGINEERING OF HIGH POLYMERS.
Sem. 2 Class 3, cr. 3 (el.)

Must be preceded by Chem. 552 and Chem. 574.

Kinetics and mechanism of formation, commercial organic technology of manufacture, industrial fabricating techniques, and principal uses of natural, artificial and synthetic fibers, plastics and elastomers. Dr. Golding.

543. CHEMICAL PROCESS LABORATORY.
Sem. 1 and 2. Lab. 3, to Lab. 9, cr. 1 to 3 (el. 7, 8 Ch, S)

Must be preceded or accompanied by Ch. E. 528. Professor Emery.

544. NUCLEAR PROCESS ENGINEERING. Class 3, cr. 3 (el.)

Must be preceded by Ch.E. 410 and Ch.E. 538 or admitted by permission of the instructor.

Chemical and metallurgical processes associated with nuclear reactors. Refining of materials for nuclear reactors and separation of products. Professor Sesonske.

555. ENGINEERING INSTRUMENTATION.

SS. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (6, 7 Ch, Met, el. E, S)

Must be preceded by Ch.E. 537 or Met.E. 204.

Professor Sherman.

558. PETROLEUM REFINERY ENGINEERING. Class 3, cr. 3

Must be preceded or accompanied by Ch.E. 538.

Application of chemical engineering fundamentals in the design of petroleum processing equipment. Professor Hite.

GRADUATE LEVEL

610. ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS.

Sem. 1. Class 3, cr. 3

Must be preceded by Ch.E. 410 or equivalent.

Review of the fundamentals of thermodynamics. Advanced topics of importance in chemical engineering, particularly with regard to composition as a variable, phase and chemical equilibria. Professor Bennett.

616. PROBLEMS IN ORGANIC TECHNOLOGY.

Sem. 1. Lab. 3, to Lab. 9, cr. 1 to 3

Open to a limited number of advanced students. Industrial problems in organic technology; laboratory work and conferences each week. Professor Doody.

617. PROBLEMS IN ORGANIC TECHNOLOGY.

Sem. 2. Lab. 3, to Lab. 9, cr. 1 to 3

Continuation of Ch.E. 616. Professor Doody.

622. HEAT TRANSFER. Sem. 1. Class 3, cr. 3

Must be preceded by Ch.E. 410, 537, 538 or equivalent.

Fundamentals of heat transmission. Professors Tierney or Smith.

623. DISTILLATION. Sem. 2. Class 3, cr. 3

Must be preceded by Ch.E. 410, 537, 538.

Fundamentals of distillation of binary and multicomponent mixtures. Professor Myers.

624. ABSORPTION AND EXTRACTION. Sem. 2. Class 3, cr. 3

Must be preceded by Ch.E. 410, 537, 538 or equivalent.

Fundamental topics and design problems in absorption, extraction and other diffusional operations. Professor Tucker.

625. FILTRATION AND MECHANICAL SEPARATIONS. Class 3, cr. 3

Must be preceded by Ch.E. 410, 537, 538 or equivalent.

Advanced problems and theory. Staff.

627. APPLIED MATHEMATICS IN CHEMICAL ENGINEERING.

SS. Class 3, cr. 3

Must be preceded by Math. 421, Ch.E. 410, 537 and 538 or equivalent.

Applications of ordinary and partial differential equations in the solution of chemical engineering problems. Professors Bennett or Myers.

628. ADVANCED UNIT PROCESSES IN ORGANIC TECHNOLOGY.

Sem. 1. Class 2, Lab. 3, cr. 3

Should be preceded by Ch.E. 528, 529 or equivalent.

Detailed and advanced study of nitrations, hydrogenations, etc., such as carried out in industry; pilot-plant laboratory. Professors Doody and Hite.

629. ADVANCED UNIT PROCESSES IN ORGANIC TECHNOLOGY. Sem. 2. Class 2, Lab. 3, cr. 3

Continuation of Ch.E. 628. Professors Doody and Hite.

635. CHEMICAL ENGINEERING FLUID DYNAMICS. Sem. 1 and 2. Class 3, cr. 3

Must be preceded by Ch.E. 537 and 538.

Advanced topics in chemical engineering unit operations with particular emphasis on fluid dynamics and problems involving a combination of unit operations. Professor Comings.

662. CHEMICAL ENGINEERING KINETICS. Sem. 2. Class 3, cr. 3

Must be preceded by Ch.E. 410, 537, 538 or equivalent.

Applications of kinetics to industrial problems in chemical engineering. Professors Smith or Woods.

690. SEMINAR IN CHEMICAL ENGINEERING. cr. 0

Required of all graduate students. Professor Comings and Staff.

698. RESEARCH IN CHEMICAL ENGINEERING.

M.S. Thesis. Staff.

699. RESEARCH IN CHEMICAL ENGINEERING.

Ph.D. Thesis. Staff.

GEOLOGY

UNDERGRADUATE LEVEL

Lower Division Courses

201. PHYSICAL GEOLOGY. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (el.)

Earth forces, processes, and resulting features. Professor Melhorn.

202. HISTORICAL GEOLOGY. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (el.)

Must be preceded by Geol. 201, 221, 341, or equivalent.

Brief synopsis of historical geology, with emphasis on stratigraphic and structural relationships. Professor Melhorn.

221. FORESTRY AND AGRICULTURAL GEOLOGY. Sem. 1 and 2. Class 3, cr. 3 (3 F, el. 5 A)

Rock types, weathering, erosion, and soils, underground and surface waters; land forms; introduction to historical geology. Professor Melhorn.

261. MINERALOGY OF ORES. Sem. 1. Class 1, Lab. 3, cr. 2 (3 Met)

Ore minerals of interest to the metallurgist. Professor Lounsbury.

UNDERGRADUATE LEVEL

Upper Division Courses

303. GEOLOGY OF NORTH AMERICA. Sem. 1. Class 2, Lab. 3, cr. 3 (el. 5 S)

Must be preceded by Geol. 202.

A study of the geomorphology and historical geology of Alaska, Canada, United States and Mexico, and their significance. Professor Melhorn.

304. ROCKS AND MINERALS. Sem. 2. Class 2, Lab. 3, cr. 3 (el. 6 S)

Must be preceded by Geol. 201 and a first course in Chemistry.

A study of the common rocks and minerals. Professor Lounsbury.

341. ENGINEERING GEOLOGY. Sem. 1 and 2. Class 2, cr. 2 (6, 7, 8 C)

A general course for senior engineers.

Application of geology to engineering practice; special attention to problems in foundations, excavation, water supply, tunneling, etc. Staff.

342. ENGINEERING GEOLOGY. Sem. 1 and 2. Class 3, cr. 3 (el. 6, 7, 8 C)
Must be preceded by Geol. 341 or equivalent.
Continuation of Geol. 341.
Staff.

462. CRYSTALLOGRAPHY. Sem. 1. Lab. 3, cr. 1 (7 Met)
Must be preceded by Math. 242 or 222 and Phys. 231, 241, or 221.
Various forms of crystals and their internal structure; methods of study, notation and projection.
Professor Lounsbury.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

525. SOIL MINERALOGY. Sem. 1. Class 2, Lab. 3, cr. 3 (el. A, C)
A student registering for this course must secure the approval of the instructor.
Soil-making minerals, their soil-making characteristics as determined by their decomposition and disintegration. Mineral analysis of soils, using modern techniques of heavy liquid separation, microscopic examination differential thermal analysis, etc. Correlation of the origin of soils with their composition and physical and chemical properties.
Professor Lounsbury.

526. SOIL MINERALOGY. Sem. 2. Class 2, Lab. 3, cr. 3 (el. A, C)
Continuation of Geol. 525.
Professor Lounsbury.

543. ADVANCED ENGINEERING GEOLOGY I.
Sem. 1. Class 1, Lab. 6, cr. 3 (el. 7 C)
Must be preceded by Geol. 341 or its equivalent.
The study of rock forming minerals, the common rocks, and the agents and products of their decomposition and disintegration.
Professor Melhorn.

544. ADVANCED ENGINEERING GEOLOGY II. Sem. 2. Class 3, cr. 3 (el. 7 C)
Must be preceded by Geol. 341 or its equivalent.
A resume of historical geology, structural geology and geomorphology as applied to varied engineering problems.
Professor Melhorn.

581. MINERAL ECONOMICS. Sem. 1 and 2. Class 3, cr. 3 (el. 7, 8)
Must be preceded by Geol. 201, 221 or equivalent.
Mineral resources, attendant national and international problems.
Staff.

591. PROBLEMS IN GEOLOGY. Sem. 1 and 2. cr. 1 to 3 (el. 7, 8)
Prerequisites dependent on nature of problem.
Investigation of original problems of specific interest to the student who has sufficient background.
Staff.

594. OPTICAL MINERALOGY. Class 1, Lab. 6, cr. 3 (el.)
Must be preceded by Geology 261 or equivalent.
A microscopic study of minerals.
Professor Lounsbury.

METALLURGICAL ENGINEERING

UNDERGRADUATE LEVEL

Lower Division Courses

201. METALLURGICAL CALCULATIONS. Sem. 2. Class 3, cr. 3 (4 Met)
Must be preceded by Chem. 101 and 102, and accompanied or preceded by Math. 241 and Phys. 230.
Heat and material balances associated with metallurgical processes and lecture discussion of professional problems.
Professor Evers.

204. GENERAL METALLURGY. Sem. 2. Class 3, cr. 3 (4 Met, el.)
Must be preceded by Geol. 261 and preceded or accompanied by Phys. 231 and Chem. 227 or equivalent.
Professor Parlee.

UNDERGRADUATE LEVEL

Upper Division Courses

303. PHYSICAL METALLURGY AND CORROSION. Sem. 1. Class 3, cr. 3 (5 Ch)

Must be preceded by Chem. 102, Phys. 230 and 231, or equivalent.

Introduction to the fundamentals of the behavior of metals and of corrosion. Professor Guy.

306. METALLURGICAL LABORATORY. SS. Lab. 9, cr. 3

Must be preceded by Met. E. 204, 310 and 311. Professor Parlee and Staff.

310. NON-FERROUS METALLURGY. Sem. 1. Class 3, cr. 3 (5 Met, el. Ch)

Must be preceded by Met. E. 204 and Chem. 227, and preceded or accompanied by Chem. 573 or equivalent. Professor Parlee.

311. FERROUS METALLURGY. Sem. 2. Class 3, cr. 3 (6 Met)

Must be preceded by Met. E. 204 and Chem. 227, and preceded or accompanied by Chem. 574 or equivalent. Professor Schuhmann.

345. ELEMENTARY METALLURGY. Sem. 1 and 2. Class 3, cr. 3 (5, 6 M, 7 ES, el.)

Must be preceded by Chem. 102, Phys. 231 or equivalent. Professor Hughel and Staff.

390. INSPECTION TRIPS AND PROFESSIONAL GUIDANCE. cr. 1/3 (6 Met)

Required inspection trips to selected metallurgical engineering industries, and lecture discussion of such matters as plant trouble shooting, project evaluation, process costs, job demands and background, mechanical safety, what industry expects of the new engineer, etc. Staff.

454. APPLIED METALLOGRAPHY. Sem. 2. Class 1, Lab. 6, cr. 3 (8 ES, el.)

Must be preceded by Met. E. 345 or equivalent. Professor Hughel.

490. INSPECTION TRIPS AND PROFESSIONAL GUIDANCE. Sem. 1. cr. 1/3 (7 Met)

Required inspection trips to selected metallurgical engineering industries, and lecture discussion of such matters as plant trouble shooting, project evaluation, process costs, job demands and background, mechanical safety, what industry expects of the new engineer, etc. Staff.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

507. PLASTIC METALLURGY. Sem. 1. Class 2, cr. 2 (8 Met)

Must be preceded by E.S. 313, Met. E. 310, 311 and 549, or equivalent. Professor Guy.

511. METALLURGICAL PROBLEMS. Sem. 1 and 2. Lab. 3, to Class 1, Lab. 9, crs. 1 to 4 (el.)

Prerequisites dependent on nature of problem. Staff.

516. PLANT DESIGN. Lab. 9, cr. 3 (el. 7, 8 Met)

Must be preceded by Met. E. 310, 311 and 549 or equivalent.

Metallurgical calculations and plant design. Staff.

517. ELECTROMETALLURGY. Sem. 1. Class 2, Lab. 3, cr. 3 (el. 7, 8 Met)

Must be preceded by Met. E. 204, 310, and 311 or equivalent.

A more advanced consideration of electric furnaces, electrolytic refining, electroplating, cleaning, pickling, etc. Professor Grace.

519. MINERAL DRESSING.

Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (7, 8 Met, el.)

Must be preceded by Met. E. 204 or Met. E. 306, or equivalent.

A study of a sequence of material preparation operations on a more advanced basis than is given in Met. E. 204 and 306. Professor Schuhmann.

521. ADVANCED NON-FERROUS METALLURGY.

Class 3, cr. 3

Must be preceded by Met. E. 204 and 310, or equivalent.

Selected topics in the production of copper, lead, zinc, gold, and minor metals. Staff.

522. ADVANCED FERROUS METALLURGY.

Class 3, cr. 3

Must be preceded by Met.E. 204 and 311, or equivalent.

Selected topics in the production of iron, steel, and ferrous alloys. Physical chemistry of iron and steel. Professor Parlee.

524. ADVANCED GENERAL METALLURGY.

Class 3, cr. 3

Must be preceded by Met. E. 204, 310 and 311, or equivalent.

Selected topics in refractories, electroplating, roasting, crushing, classification, concentration, etc. Professor Schuhmann.

525. PROBLEMS IN PRODUCTION METALLURGY.

Sem. 1. Lab. 3 to Lab. 9, cr. 1 to 3

Must be preceded by Met. E. 310 and 311 or equivalent.

Problems in concentration, reduction, refining, electroplating, etc. Staff.

526. PROBLEMS IN PRODUCTION METALLURGY.

Sem. 2. Lab. 3, to Lab. 9, cr. 1 to 3

Continuation of Met. E. 525. Staff.

535. ALLOY STEELS.

Class 2, or Class 2, Lab. 3, cr. 2 or 3

Must be preceded by Met. E. 550 or equivalent.

Ternary, quarternary, and more complex steels. Staff.

536. CAST IRON.

Class 2, or Class 2, Lab. 3, cr. 2 or 3

Must be preceded by Met. E. 550 or equivalent.

Constitution and microstructure of cast irons in relation to their properties. Staff.

537. CORROSION.

Class 2, Lab. 3, cr. 3

Must be preceded by Chem. 573 and 574, Met. E. 549, 550, and 551, or equivalent.

Theories, testing, corrosion-resisting materials; methods of combatting corrosion. Professor Evers.

549. PHYSICAL METALLURGY.

Sem. 2. Class 2, Lab. 3, cr. 3 (5 Met)

Must be preceded by Met. E. 204 and Phys. 231, and preceded or accompanied by Chem. 573 or equivalent. Professor Hughel.

550. FERROUS METALLOGRAPHY.

Sem. 2. Class 2, Lab. 3, cr. 3 (6 Met)

Must be preceded by Met.E. 549 or equivalent. Professor Evers.

551. NON-FERROUS METALLOGRAPHY.

Sem. 1. Class 2, Lab. 3, cr. 3 (7 Met)

Must be preceded by Met. E. 549 or equivalent. Professor Evers.

557. METALLURGICAL TESTING AND INSPECTION.

Class 1, Lab. 3, or Class 1, Lab. 6, cr. 2 or 3 (el.)

Open only to students with junior or higher standing.

Must be preceded by Met. E. 345 or 549.

Macro-etching, magnetic, acoustic, dimensional testing, and radiography as applied to testing and inspection. Professor Evers.

GRADUATE LEVEL

619. THEORETICAL PHYSICAL METALLURGY. Sem. 1. Class 3, cr. 3
Must be preceded by Met. E. 549, 550 and 551 or equivalent.
Newer theories of the metallic state, interpretation of experimental data, recent experimental developments of future significance. Professor Guy.

620. THEORETICAL PHYSICAL METALLURGY. Sem. 2. Class 3, cr. 3
Continuation of Met. E. 619. Professor Hughel.

623. ADVANCED EQUILIBRIA. Class 2, or Class 3, cr. 2 or 3
Must be preceded by Met. E. 620, or equivalent.
Thermodynamic treatment of equilibria in multi-component metal and non-metal systems, including P-T-X diagrams of binary systems. Professor Guy.

634. ADVANCED EXPERIMENTAL METALLOGRAPHY.
Sem. 1 and 2. Class 1, Lab. 6, cr. 3
Must be preceded by Met. E. 549, 550 and 551, or equivalent.
Advanced laboratory research in ferrous or non-ferrous materials, stressing research, initiative, and skill in original methods of attack. Professor Hughel.

659. IGNEOUS SOLUTIONS. Sem. 2. Class 3, cr. 3
Must be preceded by Chem. 573, and Met. E. 310, 311 and 549.
The fundamental properties of slags and igneous electrolytes as used in the reduction and refining of steel, copper, aluminum, magnesium, beryllium, etc.
Professor Schuhmann.

698. RESEARCH IN METALLURGICAL ENGINEERING. M.S. Thesis. Staff.

699. RESEARCH IN METALLURGICAL ENGINEERING. Ph.D. Thesis. Staff.

CIVIL ENGINEERING

Professor K. B. Woods in charge.

Professors: Bloodgood, Howland, *B.B. Lewis, Lommel, Mills, Petty, Poole, Stubbs, Woods, Wyly.

Associate Professors: Egner, *Freel, Frost, Goetz, Goldberg, Green, Gutzwiller, Hayes, A. D. M. Lewis, D. W. Lewis, Matthews, Scott, Soneson, Thoma, Wilke, Yoder,

Assistant Professors: †Camp, Curtis, Johnstone, Kay, Kemmer, Leonards, Michael, Miles.

Instructors: Altschaeffl, Baerwald, Branham, Dolch, Larew, Lenzen, Lovell, McLaughlin.

Graduate Teaching Assistantships: Boegly, Dunham, Fang, Faust, Leve, Moore, Olin, Sanborn.

Engineering Experiment Station:

Associate Professor: Parvis.

Instructors: Blackburn, Havers, Mettes, Shepard, Venters, Yeh.

Graduate Research Assistantships: Grunau, Holloway, Leighty, Raju, Robbins, Sbarounis, Snyder.

Graduate Assistantships: Amos, Becker, Bell, Bishay, Duffy, El-Naggar, Etzel, Fears, Ficks, Guiterrez, Jackman, Ku, Lottman, Osili, Poulin, Rosenfield, Ruxton, Stanley, Stylianopoulos, Walker, Wood, Ziogas.

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* Formosa-Purdue Engineering Project.

† Leave of absence 1954-55.

UNDERGRADUATE LEVEL
Lower Division Courses

100. PLANE SURVEYING. Sem. 1 or 2. Class 1, Lab. 3, cr. 2 (1, 2 Engr.)

Measurement of distances, elevations, directions, and angles, using tape, level, compass, and transit; computation of areas and traverses; field exercises illustrative of classroom topics. Professor Lommel and Staff.

102. SUMMER SURVEYING CAMP-TOPOGRAPHIC ENGINEERING. 4 weeks, cr. 4 (1 C)

A required course for freshman civil engineers, offered during the summer following their freshman year. Other students may attend.

Field and office practice in topographic mapping, elementary geodesy and engineering astronomy. Eight field or office hours each day at Ross Comp.

104. SUMMER SURVEYING CAMP—ROUTE SURVEYING. 4 weeks, cr. 4 (1 C)

A required course for freshman civil engineers offered during the summer following their freshman year. Other engineering students may attend.

Field and office practice in highway and railway location. Preliminary and final location surveys including curves, profiles, slope stakes, yardage estimates. Eight field or office hours a day at Ross Camp.

Special fees are charged for both C.E. 102 and C.E. 104. In addition, a deposit is required to cover the cost of subsistence.

262. RAILROADS. Sem. 1 or 2. Class 1, Lab. 3, cr. 2 (3 C)

Must be preceded by C.E. 104.

Maintenance; problems in frogs, switches, yards, transition spiral; quantities, cost data, monthly and final estimates. Professor B. B. Lewis.

268. HIGHWAY CONSTRUCTION. Sem. 1 or 2. Class 1, Lab. 3, cr. 2 (5 C)

Must be preceded by C.E. 104.

Location, earthwork, drainage, design, contract procedure, and maintenance. Particular emphasis on low-cost roads. Professor Petty.

269. HIGHWAY CONSTRUCTION. Sem. 1 or 2. Class 2, cr. 2 (6 C)

Must be preceded by E.S. 312.

Materials, design, construction, and maintenance of bituminous concrete and block types of roads and streets; subgrade stabilization; administration and finance; comparative values of road-surface types. Professor Petty.

UNDERGRADUATE LEVEL
Upper Division Courses

304. CARTOGRAPHY. Sem. 2. Class 1, Lab. 3, cr. 2 (C, el.)

History of chart and map making, map projections, map reproductions, consideration of scales, symbols, drafting, relief methods, compilation, interpretation, and toponomy. Professor Curtis.

331. TESTING MATERIALS. SS, Sem. 1 and 2. Lab. 2, cr. 1 (5 or 7 Aero, 5 L, M, 5 Ag7)

Must be preceded or accompanied by E.S. 312.

Similar to C.E. 35 but briefer. Professor Mills and staff.

335. ENGINEERING MATERIALS. Sem. 1 or 2. Class 2, Lab. 6, cr. 4 (6 C)

Must be preceded or accompanied by E.S. 312.

Action of materials under load; verification of theories of mechanics. Professor Mills and Staff.

341. HYDRAULICS. Sem. 1 or 2. Class 3, cr. 3 (6 C, Em, L)

Must be preceded by E.S. 204.

Pressure on submerged surfaces; flow of fluids, dynamics of flow; models. Professor Freel.

349. HYDRAULIC LABORATORY. Sem. 1 or 2. Lab. 3, cr. 1 (6 C, Em)
Must be preceded or accompanied by C.E. 341 Professor Freel.

351. WATER ANALYSIS. Sem. 1. Class 2, Lab. 3, cr. 3 (op. 5 C)
Must be preceded by Chem. 102 or 118.
Tests used in the operation and control of water purification plants.
Professor Wilke.

352. SEWAGE ANALYSIS. Sem. 2. Class 2, Lab. 3, cr. 3 (op. 6 C)
Must be preceded or accompanied by C. E. 351. Professor Bloodgood.

370. STRESSES. Sem. 1 or 2. Class 4, Lab. 4, cr. 5⅓ (5 C)
Must be preceded by E.S. 204.
Analysis of statically determinate structures; reactions, shears, bending moments, and direct stresses due to fixed and moving loads; beams and framed structures.
Professor Scott and Staff.

371. INDETERMINATE STRESSES. Sem. 1 or 2. Class 3, cr. 3 (6 C)
Must be preceded by C.E. 370 and E.S. 312.
A thorough drill in computing deflection of beams; indeterminate analysis by moment areas, consistent deflections, slope deflection, and moment distribution.
Professor Soneson and Staff.

373. FUNDAMENTALS OF STRUCTURAL DESIGN.
Sem. 2. Class 2, Lab. 3, cr. 3 (6 L, el. Engr.)
Must be preceded by E.S. 204 and 312 or 313.
Proportioning and disposition of structural elements in simple structures.

405. HYDROGRAPHIC SURVEYING. Sem. 1. Class 1, cr. 1 (el. C)
Must be preceded by C.E. 102.
Nautical charts, Navigation, and ship operation; sounding methods, wire dragging, visual and electronic position-location methods; tide, current, and magnetic observations; oceanography. Professor Egner.

422. HISTORICAL DEVELOPMENT OF CONSTRUCTION.
Sem. 1 or 2. Class 1, cr. 1 (el.)
Professor Soneson.

424. CONTRACTS AND SPECIFICATIONS. Sem. 1 or 2. Class 3, cr. 3 (8 C)
Legal principles underlying engineering work; contracts, agency, negotiable instruments, real property, torts; engineering ethics. Professors Woods and Matthews.

426. CONSTRUCTION ESTIMATES AND COSTS.
Sem. 1 or 2. Class 3, cr. 3 (op. 7 C, el.)
May be taken only by students with senior standing.
Approximate and detailed estimates; costs, direct and indirect; comparative costs, capitalized cost studies, depreciation; execution of construction work by contract or day labor. Professor Stubbs.

428. CONSTRUCTION PLANNING AND ORGANIZATION.
Sem. 1 or 2. Class 3, cr. 3 (op. 8 C, el.)
May be taken only by students with senior standing.
Construction equipment and the planning of the construction plant and organization for the execution of a construction project. Professor Stubbs.

453. SANITARY ENGINEERING SEMINAR. Sem. 2. Class 1, cr. 1 (op. 8 C)
Review of current literature. Professor Bloodgood.

459. WATER SUPPLY AND SEWERAGE.
Sem. 1 or 2. Class 3, Lab. 4, cr. 4⅓ (7 C)
Must be preceded by C.E. 341.
Water supply: design and construction of distribution systems.
Sewerage: design and construction of storm, sanitary, and combined sewers.
Professor Howland.

463. AIRPORT SELECTION AND LAYOUT. Sem. 1 or 2. Class 2, cr. 2 (8 AT)
For Air Transportation students only.

Economic factors and fundamental engineering concepts and their use in airport development. Mr. Branham and Staff.

474. THEORY OF REINFORCED CONCRETE.
Sem. 1 or 2. Class 3, Lab. 3, cr. 4 (7 C)
Must be preceded by C.E. 370 and 371.

Theory and design of slabs, beams, columns, footings and retaining walls. Staff.

476. TIMBER DESIGN. Sem. 1. Class 1, Lab. 3, cr. 2 (el. C)
Must be preceded by C.E. 371.

Design of parts of modern timber structures, exclusive of arches.
Professor Soneson.

478. STRUCTURAL STEEL DESIGN.
Sem. 1 or 2. Class 1, Lab. 9, cr. 4 (8 C)
Must be preceded by C.E. 371 and 474.

Theory and design of structural members and connections of steel by the project method. Professors Wyly and Hayes.

479. ARCHITECTURAL ENGINEERING.
Sem. 1 or 2. Class 1, Lab. 3, cr. 2 (op. 7 C, el.)
Must be preceded or accompanied by C.E. 474.

Design of simple floor and roof systems; use of building materials; drafting for plans and details for ordinary buildings; shop drawings; survey of mechanical drawing.
Professor Soneson.

480. SOIL MECHANICS. Sem. 1 or 2. Class 2, Lab. 3, cr. 3 (7 C)
Must be preceded by C.E. 335.

Principles governing the use of soils as engineering materials and application to common foundation and earthwork problems. Professor Leonards and Mr. Larew.

483. FOUNDATION ENGINEERING.
Sem. 1 or 2. Class 2, cr. 2 (op. 7, 8 C)
For construction option only.
Mr. Larew.

490. ENGINEERING INSPECTION TRIP. cr. 0 (7, 8 C)
Required of all seniors in Civil Engineering.

Inspection of engineering establishments, industrial plants, new construction, and municipal and transportation facilities. Covering two to four days during either semester or during one of the regular vacations of the academic year.
Professor Soneson.

499. RESEARCH IN CIVIL ENGINEERING. (el.)
Credit arranged.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

500. GEODETIC SURVEYING. Sem. 1. Class 1, Lab. 3, cr. 2 (el. C)
Must be preceded by C.E. 102.

Principles of geodesy; reconnaissance, signal building, triangulation, base measurement, precise leveling, plane table topography; computations, spherical and plane coordinate systems.
Professor Egner.

501. PHOTOGRAMMETRY. Sem. 2. Class 1, Lab. 3, cr. 2 (el. C)
Must be preceded by C.E. 102 and 500.

Ground control, stereoscopy, aerial cameras, flight planning, mosaics, radialline and template control methods, steroplotting instruments in mapping.
Professor Egner.

502. LAND SURVEYING. Sem. 1 or 2. Class 2, cr. 2 (el. 7 or 8 C)
Must be preceded by C.E. 102.

United States government survey of public lands. Laws of land surveying. Plats, descriptions, area computations. County planning, zoning, highways.
Professor Camp.

506. CITY PLANNING. Sem. 1 or 2. Class 2, cr. 2 (el.)

Principles of planning; street systems, transportation, recreational facilities, housing, landscape engineering.
Professor Lommel.

516. THE ORTHOTROPIC BEHAVIOR OF WOOD AND PLYWOOD.
Sem. 2. Class 2, Lab. 3, cr. 3 (el. 8 C)
(Offered in 1955-56 and alternate years.)
Must be preceded by E.S. 312 or For. 518.

For description of course, see Forestry Department, School of Agriculture.

521. RESEARCH PHOTOGRAPHY. Sem. 2. Class 1, Lab. 3, cr. 2
To be taken only with the approval of the department.

Application of photography and photographic techniques to engineering research; selection, instrumentation, and preparation of the photographic media for engineering use.
Professor Frost.

528. MUNICIPAL ENGINEERING. Sem. 1 or 2. Class 2, cr. 2 (el. 7 or 8 C)
Must be preceded or accompanied by C.E. 459.

Engineering and legal problems of the city engineer, city government, city surveys, subdivision design, building codes, legal procedures for making public improvements.
Professor Matthews.

533. APPLIED PROPERTIES OF ENGINEERING MATERIALS.
Sem. 1 or 2. Class 2, cr. 2, or Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by C.E. 335.

States of matter; viscosity, adhesion, surface tension, capillarity, plasticity, elasticity, and other properties of engineering materials.
Mr. Dolch.

542. HYDROLOGY. Sem. 1 or 2. Class 2, cr. 2 (el. C)
Must be preceded by C.E. 341.

Occurrence, utilization and control of water; atmospheric measurements, hydrography; seepage; analysis of pertinent statistics.
Professor Freel.

551. SANITARY ENGINEERING SCIENCE. Sem. 1, 2 or S. Class 2, Lab. 6, cr. 4
Class 2, Lab. 3, cr. 3
Must be preceded by C.E. 459 or by permission of the instructor.

A study of the scientific techniques and procedures used in water supply and sewage disposal practices.
Staff.

553. SANITARY ENGINEERING. Sem. 2. Class 1, Lab. 3, cr. 2 (el. C)
Must be preceded by C.E. 459.

Collection and disposal of municipal wastes; theory, design, and operation of water purification and sewage treatment plants.
Professor Howland.

560. COMPARATIVE ANALYSIS OF TRANSPORTATION. Sem. 1. Class 3, cr. 3
Open only to seniors or graduate students in engineering.

Comparative analysis of the phenomena affecting the engineering economy of our transportation systems.
Mr. Branham.

561. HIGHWAY MOTOR TRANSPORTATION. Sem. 2. Class 3, cr. 3
Open only to seniors and graduate students in engineering.

Engineering requirements of the highway and the performance of the vehicle and driver as they relate to safety, regulation, industry, commerce, and public need.
Professor Michael and Mr. Branham.

562. RAILWAY ENGINEERING. Sem. 1 or 2. Class 1, Lab. 3, cr. 2 (el. C)
Must be preceded by C.E. 262.

Relocation, regrade; economics; estimates; betterments; signaling; valuation.
Professor B. B. Lewis.

563. AIRPORT DESIGN. Sem. 1 or 2. Class 2, cr. 2 (el. C)
Must be preceded by C.E. 268 and 269.

Location, design, and construction of airports; passenger and express terminal facilities, hangars and accessory structures; field lighting; selection of runway, apron and taxiway; drainage.
Professor Yoder.

564. HIGHWAY TRAFFIC ENGINEERING.
Sem. 1 or 2. Class 2, cr. 2, or Class 2, Lab. 3, cr. 3 (el. C)
Must be preceded by C.E. 269.

Elements of highway traffic-accident records, signs, markings, and signals, roadway and intersection design and control, research, traffic administration, and public relations.
Mr. Baerwald.

565. TRAFFIC PLANNING. Sem. 1 or 2. Class 2, cr. 2 (el. C)
Must be preceded by C.E. 564.

Study of the conduct, analysis, and reporting of the comprehensive traffic survey necessary for street and highway planning in city and areal highway systems.
Professor Michael.

566. SURFACE MATERIALS OF THE UNITED STATES.
Sem. 1 or 2. Class 2, cr. 2, or Class 2, Lab. 3, cr. 3 (el. 8 C)
Must be preceded by C.E. 268 and 269.

Characteristics and distribution of soil and rock materials, including associated airport and highway design; construction and materials problems. Professor Woods.

567. INTRODUCTION TO AIRPHOTO INTERPRETATION.
Sem. 1 or 2. Class 2, Lab. 3, cr. 3 (el. 8 C)
Must be preceded by C.E. 268 and 269.

Airphoto interpretation and application in making engineering surveys for soils, highways, airports, and transportation in general. The differences between photo interpretation, map and photo reading, and photogrammetry are emphasized.
Professor Miles.

568. HIGHWAY ENGINEERING. Sem. 1. Class 2, cr. 2 (el. 7, 8 C)
Must be preceded by C.E. 268 and 269.

Structural design of roads and streets; oral and written reports on various phases of highway improvement.
Professor Petty.

569. HIGHWAY ENGINEERING. Sem. 2. Class 2, cr. 2 (el. 7, 8 C)
Must be preceded by C.E. 268 and 269.

Highway administration, organization, planning, financing, and operation; oral and written reports.
Professor Petty.

571. INDETERMINATE STRESSES. Sem. 1 or 2. Class 3, cr. 3 (el. C)
Must be preceded by C.E. 370 and E.S. 312.

Computing deflections of beams and trusses; indeterminate analysis by moment areas, consistent deflections, slope deflection, and moment distribution.
Professor Soneson and Staff.

572. STRUCTURAL PROBLEMS. Sem. 1. Class 1, Lab. 3, cr. 2 (el. C)
Must be preceded by C.E. 371.

Deflection of trusses, secondary stresses, construction problems. Professor Hayes.

573. STRUCTURAL LABORATORY. Sem. 1. Lab. 3, cr. 1 (el. C)
Must be preceded by C.E. 371.

Laboratory studies of structural models and components; mechanical analysis, stress measurements, critical examination of theory.
Professor Scott.

574. STRUCTURAL LABORATORY. Sem. 2. Lab. 6, cr. 2 (el. C)
Must be preceded by C.E. 573.

Experimental techniques used to evaluate structural behavior, theory and analysis. Use of various types of strain gages and other types of instrumentation. Correlation of values calculated from theoretical and working formulae. Testing of structural elements.
Professor Scott.

576. ADVANCED REINFORCED CONCRETE. Sem. 2. Class 2, cr. 2 (el. C)
Open to undergraduates with a grade of C (4) or better in C.E. 474 and to graduate students.

Continuation of C.E. 474. Plastic theory and its relation to design, pre-stressed concrete, flat slab floor systems, two-way reinforced floor slabs and reinforced concrete bridges; use of design tables and curves. Professor Gutzwiller.

577. INDETERMINATE ANALYSIS. Sem. 1 or 2. Class 2, cr. 2 (el. C)
Open to undergraduate students with a grade of C (4) or better in C.E. 371 and to graduate students.

Deflection of beams and trusses by geometry and work, reciprocal deflections, influence lines for indeterminate beams and frames, and the analysis of frames with and without the side-sway.
Staff.

578. STRUCTURAL ERECTION PROBLEMS.
Sem. 1 or 2. Class 1, Lab. 3, cr. 2 (el. C)
Open to undergraduates with a grade of 5 or better in C.E. 471.

Problems in the erection of bridges and buildings; truss deflections, camber and closing diagrams, falsework design, derrick and erection stresses, design of connections by pins, bolts, rivets and welding. Professor Wyly and Staff.

581. SOIL TESTING FOR ENGINEERING PURPOSES.
Sem. 1 or 2. Class 1, Lab. 3, cr. 2
Must be preceded by C.E. 480 or C.E. 680.

Field soil exploration, specific gravity, mechanical analysis, Atterberg limits, conpaction, field density and moisture content, and California Bearing Ratio Tests.
Professor Leonards and Staff.

583. FOUNDATION ENGINEERING.
Sem. 1 or 2 Class 2, cr. 2 (el. 8 C)
Must be preceded by C.E. 480.

Subsoil investigations; shallow foundations; pile and caisson foundations; sheeting and bracing, control of water in excavations; external equilibrium of retaining walls, bridge abutments, and cofferdams. Professor Leonards and Staff.

597. CIVIL ENGINEERING PROJECTS. (el.)
Hours and credits to be arranged. Staff.

GRADUATE LEVEL

630. CONCRETE MIXES. Sem. 1. Class 2, Lab. 3, cr. 3
Must be preceded by C.E. 335.

Void-cement ratio, fineness modulus, solid volume, and other methods of mix design. Volume change, flow, elasticity, fatigue, and other characteristics.
Professor Mills.

631. AGGREGATES AND AGGREGATE TESTING. Sem. 2. Class 2, cr. 2
Must be preceded by C.E. 630.

Identification and testing of aggregates for concrete and bituminous mixes; significance of tests; problems and techniques of aggregate research; recent developments in aggregate testing. Professor D. W. Lewis.

635. BITUMINOUS MATERIALS AND THEIR HIGHWAY USES. Sem. 1. Class 2, Lab. 3, cr. 3

Must be preceded by C.E. 268 and 269.

Manufacture and testing of bituminous materials, including asphalt cements, cutback asphalts, road oils, asphalt emulsions, and tars; specifications for these materials and their meaning; aggregate specifications, including coating and adhesion problems; use of bituminous materials in highway construction. Professor Goetz.

636. DESIGN OF BITUMINOUS MIXES. Sem. 2. Class 2, Lab. 3, cr. 3

Must be preceded by C.E. 635.

Theory and design of bituminous-aggregate mixes by aggregate surface area, void content, and other methods; strength, temperature susceptibility, weathering resistance, and other characteristics; the testing of bituminous aggregate mixes, including research methods and results. Professor Goetz.

641. ADVANCED HYDRAULICS. Sem. 1. Class 1, Lab. 3, cr. 2

Must be preceded by C.E. 341 and C.E. 459.

Non-uniform and unsteady flow in pipes and open channels. Professor Howland.

642. ADVANCED HYDROLOGY. Sem. 2. Class 1, Lab. 3, cr. 2

Must be preceded by C.E. 542.

Flood routing, flood retention, reservoir analysis, and application of statistics to hydrological problems. Professor Howland.

651. THEORY AND DESIGN OF WATER DISTRIBUTION AND WATER TREATMENT PLANTS. Sem. 2. Class 2, Lab. 6, cr. 4

Must be preceded by C.E. 351. Professor Wilke.

652. THEORY AND DESIGN OF SEWERAGE SYSTEMS AND SEWAGE TREATMENT PLANTS. Sem. 1. Class 2, Lab. 6, cr. 4

Must be preceded by C.E. 352. Professor Bloodgood.

653. ADVANCED SANITARY ENGINEERING LABORATORY. Sem. 1 or 2. Lab. 4, cr. 2, or Lab. 6, cr. 3

Must be preceded by C.E. 352. Professor Bloodgood.

654. ENVIRONMENTAL SANITATION. Sem. 1, 2 or S. Class 2, cr. 2

Must be preceded by C.E. 459 or by permission of the instructor.

A study of the environmental factors that are important in promoting good public health. (Drainage, insects, rodents, water, sewage, garbage, lighting, ventilation, foods, noise, and air.) Professor Bloodgood.

655. PUBLIC HEALTH ENGINEERING PRACTICE. Sem. 1 or 2. Class 2, cr. 2

Must be preceded by C.E. 553.

U. S. Public Health Service and state boards of health functions and practices in water supply, sewage disposal, industrial hygiene, swimming pools, and food and milk sanitation. Professor Wilke.

656. INDUSTRIAL WASTE DISPOSAL. Sem. 2. Class 3, cr. 3

Must be preceded or accompanied by C.E. 352. Professor Bloodgood.

660. TRANSPORTATION. Sem. 1. Class 3, cr. 3

Must be preceded by C.E. 562 or 569.

Commodity and passenger movements by all forms of transportation; economic fields of operation; coordination. Staff.

661. TRANSPORTATION. Sem. 2. Class 3, cr. 3

Continuation of C.E. 660. Staff.

663. ADVANCED AIRPORT DESIGN. Sem. 2. Class 2, cr. 2

Must be preceded by C.E. 563 and 666 and accompanied or preceded by C.E. 667.

Site selection and runway layout and design, application of airphotos, soil and geological maps, and topographic sheets for location and layout. Professor Yoder.

666. HIGHWAY AND AIRPORT MATERIALS.
Sem. 1 or 2. Class 3, Lab. 3, cr. 4, or Class 3, cr. 3
Must be preceded by C.E. 268 and 269.

Distribution, engineering characteristics and utilization of soils and materials of construction; embankments, subgrade treatment, stabilization foundation problems, soil profiles, and drainage; use of geology and pedology. Professor Woods.

667. ADVANCED AIRPHOTO INTERPRETATION.
Sem. 2. Class 2, Lab. 3, cr. 3, or Class 2, cr. 2
Must be preceded by C.E. 666.

Principles, techniques, uses, applications and limitations of airphoto interpretation, including the identification of soils and rocks with airphotos, site selection, identification of materials of construction, a study of landforms, and the preparation of engineering soil maps. Professor Frost.

668. PAVEMENT DESIGN. Sem. 1. Class 2, cr. 2, or Class 2, Lab. 3, cr. 3
Must be preceded by C.E. 268 and 269.

Rigid and flexible pavement slabs; transverse and longitudinal joints, temperature and warping stresses, and thickness of concrete pavements; base courses and thickness of flexible pavements. Professor Yoder.

670. NUMERICAL METHODS IN STRUCTURAL ENGINEERING.
Sem. 1 or 2. Class 3, cr. 3 (el. C)
Must be preceded by C.E. 672 and Math. 421.

Method of successive approximations to stress analysis and vibration analysis of structural frameworks; numerical methods for the calculation of beam deflections, buckling of non-uniform columns, diaphragms and webs. Professor Goldberg.

671. REVIEW OF RESEARCH ON STRUCTURAL MEMBERS.
Sem. 1. Class 3, cr. 3
Must be preceded by C.E. 371.

Brief review of research on structural members and connections with a critical examination of design assumptions and specifications.
Professors Wyly and Goldberg.

672. RIGID FRAME ANALYSIS. Sem. 1. Class 3, cr. 3
Must be preceded by C.E. 371.

Basic procedure in analysis of rigid frames for members of constant and variable I, including wide members, by geometry and by work. Beam deflections, reciprocal deflections, influence lines, redundants, slope deflection, moment distribution.
Professor Wyly.

673. STRUCTURAL VIBRATIONS AND IMPACT.
Sem. 2. Class 1, Lab. 6, cr. 3 (el. C)
Must be preceded by E.S. 562 and C.E. 672.

Theory of and experiments on vibration and impact in structural units; natural frequencies, modes of vibration, damping, resonance, and measurement of impact stresses and deflections. Professors Wyly and Goldberg.

674. BRIDGE ENGINEERING. Sem. 2. Class 1, Lab. 6, cr. 3
Must be preceded by C.E. 572 and C.E. 583.

Moveable and long-span bridges, economic layouts, cofferdam and deep-foundation problems. Professor Hayes.

675. BRIDGE ENGINEERING: ARCHES. Sem. 2. Class 1, Lab. 6, cr. 3
Must be preceded by C.E. 371.

Analysis and design of arches. Professor Goldberg.

676. BRIDGE ENGINEERING: SUSPENSION BRIDGES.
Sem. 2. Class 2, Lab. 3, cr. 3
Must be preceded by C.E. 672.

Analysis and design of suspension bridges. Professor Wyly.

677. BUILDING ENGINEERING. Sem. 2. Class 1, Lab. 6, cr. 3
Must be preceded by C.E. 672.

Analysis and design problems in industrial and office buildings. Professor Hayes.

678. ADVANCED PROBLEMS IN STRUCTURAL FRAMEWORK.
Sem. 1 or 2. Class 3, cr. 3 (el. C)
Must be preceded by C.E. 672.

Torsion of unsymmetrical buildings under wind load; Vierendeel trusses; interaction of bents, twisting of girders; girders curved in plan. Professor Goldberg.

679. BUCKLING PROBLEMS IN STRUCTURAL ANALYSIS.
Sem. 1 or 2. Class 3, cr. 3 (el. C)
Must be preceded by Math, 421 and C.E. 672.

Buckling of frameworks; interaction of members; slope deflection and moment distribution with axial loads. Professor Goldberg.

680. SOIL MECHANICS. Sem. 1 or 2. Class 2, Lab. 3, cr. 3

Soil physics, strength and deformation characteristics, seepage; problems of earth pressure, bearing capacity, slides and settlement. Professor Leonards.

681. ADVANCED SOIL TESTING FOR ENGINEERING PURPOSES.
Sem. 1 or 2. Class 1, Lab. 6, cr. 3
Must be preceded by C.E. 581 and C.E, 680.

Unconfined and triaxial strength tests, permeability, consolidation and field load-bearing tests. Professor Leonards.

682. GROUND WATER AND SEEPAGE. Sem. 2. Class 3, cr. 3
Must be preceded by C.E. 680.

Hydromechanics of confined and unconfined flow of water through soils, types of earth dams and earth dam design, flow toward wells. Professor Leonards.

683. ADVANCED FOUNDATION ENGINEERING. Sem. 1 or 2. Class 3, cr, 3
Must be preceded by C.E. 680.

Subsoil investigations; shallow foundations; piles and pile foundations; caissons; sheeting and bracing; control of water; external equilibrium of retaining walls; bridge abutments and cofferdam. Professor Leonards.

684. APPLIED SOIL MECHANICS. Sem. 2. Class 3, cr. 3
Must be preceded by C.E. 681 and 683.

Study of full-scale soils and foundations problems, including the analysis of failures and recommendations for their correction; engineering reports required. Professor Leonards.

697. CIVIL ENGINEERING PROJECTS.
Hours and credits to be arranged. Staff.

698. RESEARCH; MASTER OF SCIENCE THESIS. Staff.

699. RESEARCH; DOCTOR OF PHILOSOPHY THESIS. Staff.

ENGINEERING SCIENCES

Professor Chenea in charge.

Professors: Bogdanoff, Chenea, Cutshall, Fairman, Girvin, Sanders, Stitz, Waling.
Associate Professors: Eringen, Geldmacher, Hancock, Little, Trabant.
Assistant Professors: Anderson, Gossick, Lawton.
Instructors: Cooper, Douglas, Dunkin, Feuer, Gray, Hollister, Houstrup, Lambert, Richardson, Streeter, Wooldridge.
Graduate Assistants: Jones, Parfitt, Samuels.
Extension Centers—Instructor: Horner.

ENGINEERING SCIENCES

UNDERGRADUATE LEVEL

Lower Division Courses

201. STATICS. Sem. 1 and 2. Class 3, cr. 3 (4 Ch., 5 Met., el.)
Must be preceded by Phys. 230 and preceded or accompanied by Math. 242.

Forces, vectors, moments, equilibrium, friction, center of gravity and moments of inertia.
Professor Little and Staff.

202. KINETICS. Sem. 1 and 2. Class 2, cr. 2 (5 Ch., 6 Met., el)
Must be preceded by E.S. 201 and Math. 242.

Force, mass, acceleration, velocity, inertia, work, energy, power, impulse and momentum.
Professor Little and Staff.

203. STATICS AND MECHANICS OF MATERIALS. Class 3, cr. 3 (Ch.E.)

Equilibrium of force systems, centroids, moment of inertia of areas, stress, strain, beams, shafts, combined stresses.

204. STATICS AND KINETICS. SS. Sem. 1 and 2.
Class 5, cr. 5 (4 Aero. C, L, M, 5 AgE., E)
Must be preceded by Phys. 230 and preceded or accompanied by Math. 242.

Statics: forces, vectors, moments, equilibrium, friction, centers of gravity and moments of inertia.

Kinetics: force, mass, acceleration, velocity, inertia, work, energy, power, impulse and momentum.
Professor Little and Staff.

205. BASIC MECHANICS I. Sem. 1. Class 3, cr. 3 (3 E.S.)
Must be preceded by Math. 241.

Fundamental concepts, force systems, graphical representation of force systems, equilibrium, distributed forces, hydrostatics, virtual work, static stability, friction. First and second moments of areas, volumes, and masses, center of gravity. Application to structural and machine elements such as bars, beams, trusses, cables, friction devices.

206. BASIC MECHANICS II. Sem. 2. Class 3, cr. 3 (4 E.S.)
Must be preceded by E.S. 205 and Math. 242.

Fundamental concepts, kinematics, translation and rotation. Kinetics, impulse, momentum, work, energy. Rectilinear and curvilinear translation of point masses. Plane motion of rigid bodies and vibration. Application to projectiles, gyroscopes, machine elements and other engineering systems.

207. ELEMENTARY MECHANICS. Class 3, cr. 3 (4 A.E.)
Must be preceded by Phys. 240 and Math. 242.

Work: Virtual work; potential energy; equilibrium, kinematics in two dimensions; dynamics in two dimensions.

210. ENGINEERING MECHANICS. Sem. 1. Class 3, cr. 3 (op. 5, A.T.)
Must be preceded by Math. 142 and Phys. 220.

Statics, kinetics, and mechanics of materials, with special reference to the needs of Air Transportation students.
Professor Hancock.

271. EXPERIMENTAL ENGINEERING SCIENCE I.
Sem. 1. Lab. 3, cr. 1 (3 E.S.)
Prerequisite: Consent of Department.

Experiments designed to illustrate fundamental phenomena and laboratory techniques. Coordinated experiments to include methods of measurement of length, force, time. Experiments in equilibrium, friction, centroids. Evaluation of data and determination of errors.

272. EXPERIMENTAL ENGINEERING SCIENCE II. Sem. 2, Lab. 3, cr. 1 (4 E.S.)

Prerequisite: Consent of Department.

Experiments in dynamics, thermodynamics, heat transfer, and properties of engineering materials.

UNDERGRADUATE LEVEL

Upper Division Courses

304. DYNAMICS. Class 3, cr. 3 (Ch.E.)

Newton's laws, moment of inertia of mass, work, energy, power, momentum, impulse, dynamic stresses in rods and beams.

312. MECHANICS OF MATERIALS. SS. Sem. 1 and 2, Class 4, cr. 4 (5 Aero, C, L, M)

Must be preceded by E.S. 204 and Math. 242.

Stress and strain: properties of materials; torsion; shear and moment; bending and deflection of beams; statically indeterminate beams; combined stresses; columns.

Professor Cutshall and Staff.

313. MECHANICS OF MATERIALS. SS. Sem. 1 and 2. Class 3, cr. 3 (5 AgE., 6 E, 7 Ch., 7 Met)

Must be preceded by E.S. 204 and Math. 242.

A briefer course than E.S. 312. Stress and strain; properties of materials; torsion; some shear and moment; bending and deflection of beams.

Professor Cutshall and Staff.

314. MECHANICS OF SOLIDS. Sem. 2. Class 4, cr. 4 (4 E.S.)

Must be preceded by E.S. 205 and Math. 242.

Concept of stress and Hooke's Law, analysis of axial force members and systems, shearing stress, combined stresses and strains, the generalized Hooke's Law, stresses due to bending of beams, deflection of beams, statically indeterminate beams, torsion of bars, theory of instability of columns, strain energy.

373. EXPERIMENTAL ENGINEERING SCIENCE III. Sem. 1. Class 1, Lab. 3, cr. 2 (5 E.S.)

Prerequisite: Consent of Department.

Fundamental concepts of probability and statistics. Application of statistical techniques to experiments. Experiments in thermodynamics and mechanics of solids and fluids.

374. EXPERIMENTAL ENGINEERING SCIENCE IV. Sem. 2. Lab. 3, cr. 1 (6 E.S.)

Prerequisite: Consent of Department.

Experiments in dynamics, electricity, magnetism, and light; photoelasticity, strain gages, brittle lacquer, and other techniques of experimental stress analysis.

403. GRAPHICS. Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el.)

Must be preceded by E.S. 204.

Graphical analysis of trusses, cranes, mechanisms with and without friction, centers of gravity, and moments of inertia.

Professor Fairman.

471. ENGINEERING RESEARCH, DESIGN AND DEVELOPMENT I. Sem. 1. Class 2, Lab. 3, cr. 3 (7 E.S.)

Prerequisite: Consent of Department.

Projects of a research, design or development nature. The student will be expected to define the problems, select a method of approach, develop the theory, design an experiment to check the theory, set up the experiment, collect and analyze the data, compare results with the theory. Each project will terminate with a critical report of the work performed and a proposed program for further research. This course is designed to utilize and coordinate all the formal course work contained in this curriculum.

472. ENGINEERING RESEARCH, DESIGN, AND DEVELOPMENT II. Sem. 2. Class 2, Lab. 6, cr. 4 (8 E.S.)

Prerequisite: Consent of Department.

Continuation of E.S. 471.

479. APPLICATIONS OF EXPERIMENTAL STRESS ANALYSIS. Sem. 2. Class 2, Lab. 3, cr. 3 (el.)

Must be preceded by E.S. 312 or 313.

Introduction to the techniques of analysis of stress, strains, and friction by experimental means. Same as M.E. 479.

490. ENGINEERING INSPECTION TRIP. cr. 0 (7, 8 E.S.)

Required of all seniors in the curriculum of Engineering Sciences.

Inspection of engineering establishments, industrial plants, industrial research laboratories. Covering two to four days during either semester or during one of the regular vacations of the academic year.

499. RESEARCH IN ENGINEERING MECHANICS. Staff.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

502. DYNAMICS. SS. Sem. 2. Class 3, cr. 3 (el.)

Must be preceded by E.S. 312 and Math. 421.

Relative motions; accelerations, velocities and displacements for compound motions; Coriolis' Law; centrifugal and inertia effects; critical speeds; impulse and momentum; gyroscopic effects. A term paper is required. Professor Fairman.

507. BASIC MECHANICS III. Sem. 2. Class 3, cr. 3 (6 E.S.)

Must be preceded by E.S. 206 or 207 or 502.

Fundamental laws of mechanics. Lagranges equations, virtual work, applications to particle dynamics. Constraints and generalized coordinates, static and dynamic coupling. Rigid body motion, perturbation theory, theory of small oscillations, vibrations of discrete and continuous systems, acoustics, stability of motion. Applications to engineering systems. Professor Bogdanoff.

514. ADVANCED MECHANICS OF MATERIALS. Sem. 1 or 2. Class 3, cr. 3 (el.)

Must be preceded by E.S. 312.

Advanced studies of flexture and torsion; energy methods, Castigliano's theorem, complementary energy theorem; indeterminate machinery and structural members; inelastic action; introduction to ultimate load analysis of indeterminate members; elastic and inelastic instability. Professor Waling.

516. NUMERICAL METHODS IN ENGINEERING. Class 3, cr. 3 (el.)

Must be preceded by E.S. 543.

Numerical procedures for solution of eigenvalue problems; propagation problems; finite difference methods, extropolation procedures, relaxation method; moment distribution, computers. Professor Waling.

521. STRENGTH OF MATERIALS. SS. Sem. 1 or 2. Class 3, cr. 3 (el.)

Must be preceded by E.S. 312 or 313 and C.E. 331 or 335 or Met. 549.

Strength of materials as such; true stress-true strain relations; elastic strength; flow strength; fracture strength; effects of state of stress, temperature, speed of loading, cycles of loading, duration of load and previous history of the materials. A term paper is required. Professors Cutshall and Hancock.

532. THEORY OF MATERIAL PROPERTIES.
Sem. 2. Class 3, cr. 3 (6 E.S.)
Must be preceded by E.S. 312, 313 or 314 and M.E. 310.

Microscopic structure of gases, liquids, crystals and amorphous materials. Quantitative basis for correlation of mechanical properties such as flow strength, creep strength, viscosity, hardness and fatigue life, Mechanical microscopic models for elasticity, viscosity, thermal conductivity, electrical conductivity and specific heat. Time dependent models, relaxation time, and hysteresis. Mrs. Feuer.

543. CONTINUUM MECHANICS I. Sem. 1. Class 4, cr. 4 (7 E.S., el.)
Must be preceded by E.S. 312 or 314 and Math. 525 and 533.

Concept of stress and strain tensor. Analysis of stress, analysis of strain, stress and strain relations, velocity conditions, compatibility equations, equations of elasticity and ideal plastic flow, plane problems, torsion, plate problems, limit design.
Professor Trabant.

544. CONTINUUM MECHANICS II. Sem. 2. Class 4, cr. 4 (8 E.S., el.)
Must be preceded by M.E. 310 and E.S. 543.

Continuation of Continuum Mechanics I. Applications to liquids and gases. Flow in closed and open channels. Lift, drag and moment on airfoils. Supersonic flow and shock fronts. Turbulence, acoustics, noise. Sound generation, transmission and absorption.
Professor Trabant.

546. THEORY OF ELASTIC STABILITY. Sem. 1 or 2. Class 3, cr. 3 (el.)
Must be preceded by E.S. 521 and Math. 421.

Buckling of compression members with or without transverse loads, eccentricity and curvature; consideration of loads causing stresses above the elastic limit. Staff.

562. BASIC VIBRATIONS. Sem. 1 or 2. Class 3, cr. 3 (el.)
Must be preceded by E.S. 312 and Math. 421.

Principles of harmonic motion; free and forced vibrations with one, two, or many degrees of freedom; damped vibration (velocity damping) with various degrees of freedom; other forms of damping; approximation of complex systems by such methods as Rayleigh's, Holzer's, etc. Professors Bogdanoff and Little.

564. SYSTEMS ANALYSIS AND SYNTHESIS.
Sem. 2. Class 3, cr. 3 (8 E.S., el.)
Must be preceded by Physics 537 or equiv., Math. 525 and 533 or equiv.

The notion of response; open and closed chain mechanical, electrical, hydraulic, chemical, thermal systems; stability criteria; analogs.
Professors Geldmacher and Bogdanoff.

573. EXPERIMENTAL STRESS ANALYSIS.
SS. Sem. 1 or 2. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by E.S. 521.

Theory and application of photoelastic, electric strain gage, and brittle lacquer methods of experimental stress analysis for static loadings. Strain gage work will include strain rosettes. Professors Stitz and Lawton.

577. MEASUREMENTS OF DYNAMIC MECHANICAL PHENOMENA.
Sem. 1 or 2. Class 2, Lab. 3, cr. 3
Must be preceded by E.S. 312 and E.E. 515 or permission of the instructor.

Notion of Dynamic Response as developed by means of Fourier Series and Fourier Integral; application to transducers and associated transmitting and read-out devices.
Professor Geldmacher.

581. NUCLEAR ENGINEERING. Sem. 1. Class 3, cr. 3 (7 E.S., el.)
Must be preceded by E.S. 532.

Fundamentals of energy conversion involving nuclear fission; engineering aspects of reactor design, control and operation; engineering uses of radiation and radioactive materials.
Professor Gossick.

590. ADMINISTRATION AND ORGANIZATION OF RESEARCH.
Sem. 1 or 2. Class 3, cr. 3

Principles of organization and administration of research and development teams. Design of research programs and research laboratories. Legal aspects and patent policies concerning research.
Professor Chenea.

597. ENGINEERING MECHANICS PROJECTS.
Hours and credits to be arranged.
Staff.

GRADUATE LEVEL

606. CLASSICAL MECHANICS. Sem. 1 or 2. Class 3, cr. 3 (el.)
Must be preceded by E.S. 507.

Ignorable coordinates, Routh's function, Hamilton's equations, theory of small vibrations, Hamilton's principle, principle of least action, Hamilton-Jacobi theory.
Professor Bogdanoff.

640. THEORY OF ELASTICITY. Sem. 2. Class 3, cr. 3
Must be preceded by E.S. 543.

Stress and strain tensors in curvilinear coordinates; equations of motion; stress-strain relations; boundary value problems; elastic energy and related theorems; advanced application to plane problems and problems in space; torsion; bending; introduction to theory of plates and shells.
Professor Eringen.

643. THEORY OF A CONTINUOUS MEDIUM. Class 3, cr. 3
Prerequisite: Permission of instructor.

General kinematics of a continuous medium, intrinsic coordinates, consequences of the conservation of mass, momentum, energy and the inadmissibility of decreasing entropy. Specialization to the classical theories of elasticity, plasticity and fluid mechanics.
Professor Eringen.

645. ELASTIC WAVE PROPAGATION. Sem. 1 or 2. Class 3, cr. 3
Must be preceded by E. S. 543.

Brief review of theory of continuous medium; equations of motion; boundary and initial value problems; existence and uniqueness theorems; theorems in free and forced oscillations; propagations in infinite and bounded media; bar and plate theories; introduction to plastic waves.
Professor Eringen.

647. THEORY OF PLATES AND SHELLS. Sem. 1 or 2. Class 3, cr. 3
Must be preceded by E.S. 543.

Equations of equilibrium for plates and slabs; boundary conditions; equations of equilibrium for cylindrical shells; special loadings; spherical shells and domes.
Professor Eringen.

652. THEORY OF PLASTICITY. Sem. 1 or 2. Class 3, cr. 3 (el.)
Must be preceded by E.S. 543.

Theories of plastic flow and deformation. Theories of the ideal plastic, and work hardenable materials; applications to the tension test and simple state of stress. Plastic design of beams, plates, columns, pressure vessels and shafts. Plastic deformation in extrusion, drawing and other metal-forming operations.
Professor Chenea.

662. VIBRATIONS. Class 3, cr. 3 (el.)
Must be preceded by E.S. 507.

Systems having finite number of degrees of freedom, with and without damping Free and forced motion. Introduction to vibration of continuous systems.
Professor Bogdanoff.

673. EXPERIMENTAL STRESS ANALYSIS. Sem. 1 or 2. Class 2, Lab. 3, cr. 3
Must be preceded by E.S. 573.

Advanced theory and laboratory techniques for experimental stress analysis.
Professor Stitz.

697. ENGINEERING SCIENCES PROJECTS.
Hours and credits to be arranged.

698. RESEARCH; MASTER OF SCIENCE THESIS.

699. RESEARCH; DOCTOR OF PHILOSOPHY THESIS.

ELECTRICAL ENGINEERING

Professor J. S. Johnson in charge.

Professors: Beck, Blalock, *Bowman, Cage, Canfield, Eaton, George, J. S. Johnson, Mueller, Sabbagh, R. P. Siskind.

Associate Professors: Burnett, Clark, Cooper, Curtner, Freeman, Hale, Happell, Hayt, Heim, Hesselberth, Kramer, LaMothe, †Marshall, Nichols, Partridge, Sprague, Ward.

Assistant Professors: Fitzpatrick, Oorthuys, Schuder, C. S. Siskind, Spencer.

Instructors: Bjorndahl, Chalmers, Chapman, Cheng, Coon, Crawford, El Abiad, David L. Johnson, Kemmerly, Kopplin, Masnaghetti, Shelley, †Shoemaker, Travis.

Graduate Teaching Assistants: Baron, Busler, Haneman, Harmon, Lin, Magnin, McWilliams, Sarture, Wei.

Engineering Experiment Station—Instructors: DuWaldt, French, Hunt.

UNDERGRADUATE LEVEL
Lower Division Courses

201. ELECTRIC AND MAGNETIC CIRCUITS.
SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (3 E)
Must be preceded or accompanied by Math. 241 and Phy. 240.

Applications of Kirchhoff's laws; properties of electric circuits; properties of magnetic circuits; no-load characteristics of d-c generators.

Professors Mueller, Kramer, and Staff.

202. ELECTRIC AND MAGNETIC CIRCUITS AND FIELDS.
SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (4 E)
Must be preceded by E.E. 201 and preceded or accompanied by Math. 242 and Phy. 241.

Characteristics of d-c generators and motors; magnetic field relations; transients in inductive and capacitive circuits; electric field relations.

Professors Mueller, Nichols, and Staff.

UNDERGRADUATE LEVEL
Upper Division Courses

303. ALTERNATING-CURRENT CIRCUITS I.
SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (5 E)
Must be preceded by E.E. 202 and Math. 242.

Single-phase circuits, complex quantities, resonance, vector loci, and network theorems.

Professor Bowman and Staff.

304. ALTERNATING-CURRENT CIRCUITS II.
SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (6 E)
Must be preceded by E.E. 303.

Coupling, filters, nonsinusoidal waves, and polyphase circuits.

Professor Bowman and Staff.

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* Formosa—Purdue Engineering Project.

† Leave of absence 1954-55.

306. ELECTRONICS I. SS. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (5 E)
Must be preceded or accompanied by E.E. 303 or 316.
Electron dynamics, tube characteristics, and rectifiers.
Professor Hesselberth and Staff.

307. ELECTRONICS II. SS. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (6 E)
Must be preceded by E.E. 306 and preceded or accompanied by E.E. 304.
Amplifiers, oscillators, and electronic instruments.
Professor Happell and Staff.

308. ELECTRICAL MEASUREMENTS I.
Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (5 E)
Must be preceded by E.E. 202.
D-c instruments, bridges, potentiometers, and magnetic measurements.
Professor Canfield and Staff.

309. ELECTRICAL MEASUREMENTS II.
Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (6 E)
Must be preceded by E.E. 303, 306, and 308.
A-c indicating instruments and bridges, oscillographs, and r-f measurements.
Professor Marshall and Staff.

313. APPLIED ELECTRICITY. Sem. 2. Class 3, Lab. 2, cr. 3.7 (el. I)
Must be preceded by Math. 111 and 112 and Phy. 221.
Electric circuits, instruments, rates, machines, and applications.
Professor Beck and Staff.

315. ELECTRICAL ENGINEERING—D. C.
SS. Sem. 1 and 2. Class 3, Lab. 2, cr. 3.7 (5, 6, 7 Engr.)
Must be preceded by Math. 242 and Phys. 231 or 241.
D-c circuits and machines and simple a-c circuits. Professor Beck and Staff.

316. ELECTRICAL ENGINEERING—A.C.
SS. Sem. 1 and 2. Class 3, Lab. 2, cr. 3.7 (6, 7, 8 Engr.)
Must be preceded by E.E. 315.
Single-phase and polyphase circuits, transformers, induction motors, synchronous machines, rectifiers, and other electrical equipment. Professor Beck and Staff.

326. ELECTRICAL WIRING AND CONTRACTING.
Sem. 1 and 2. Class 3, cr. 3 (el.)
Must be preceded by E.E. 303, 315, or 412.
Indoor, underground, and overhead electrical construction and devices, plans, specifications, and estimates. Professor Marshall.

342. ELECTRIC CIRCUIT THEORY. Class 3, cr. 3
Must be preceded by E.E. 303.
Engineering extension course for credit. Basic electric theory, network theorems.
Professor Sabbagh and Staff.

405. ALTERNATING-CURRENT MACHINES.
SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (7 E)
Must be preceded by E.E. 304.
Theory and characteristics of transformers, induction motors, synchronous generators and motors. Professor Mueller and Staff.

409. ENGINEERING ADMINISTRATION.
Sem. 1 and 2. Class 3, cr. 3 (8 E)
Must be preceded by Econ. 210 and E.E. 304.
Value and use of money; depreciation, economic selection, cost determination; business law, engineering procedures, and professional ethics.
Professor Canfield and Staff.

412. ELECTRICAL ENGINEERING FOR CIVIL ENGINEERS.
Sem. 1 and 2. Class 3, Lab, 3, cr. 4 (4 E.S., 5 A.E., 8 C)
Must be preceded by Math. 242 and Phy. 231.

Basic d-c circuits and machines and simple a-c circuits and machines.
Mr. Chapman and Staff.

423. ELECTRICAL DESIGN. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded or accompanied by E.E. 405.

Application of the theory of electromagnetic circuits to the calculation and design of a-c and d-c apparatus and machines. Professor Curtner.

425. ELECTRICAL ENGINEERING PROJECTS.
Sem. 2. Class 2, Lab. 6, cr. 4 (el.)
Must be preceded by E.E. 405.

Application engineering problems in class and laboratory dealing with transformer connections, motors, meters, and power rectifiers. Staff.

496. RESEARCH IN ELECTRICAL ENGINEERING. Class 1, Lab. 6, cr. 3 (el.)
Staff.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

501. ELECTRICAL CONTROL SYSTEMS. Class 3, cr. 3 (el.)
Must be preceded by E.E. 316 or 405.

Application of relays, contactors, and similar equipment to the control of electrical machinery and processes. Professor Fitzpatrick.

505. ADVANCED ELECTRICAL MEASUREMENTS. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by E.E. 309.

Magnetic and electrical measurements and the measurements of non-electrical quantities by electrical methods; maintenance of primary standards, calibration procedures. Professors Canfield and Marshall.

507. ENERGY AND DEMAND MEASUREMENT. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by E.E. 304.

Meter design and manufacturing procedures, functions of meter department.
Professor Canfield.

514. ELECTRONIC CIRCUITS. Class 2, Lab. 3, cr. 3 (6 A.E.)
Must be preceded by E.E. 316 or 412 or Phys. 330 and Math. 242 or equivalent.

D-c and a-c circuit theory. Steady-state and transient behavior of circuits. Major emphasis on electronic applications. Professor LaMothe and Staff.

515. ELECTRICAL MEASUREMENT OF NON-ELECTRICAL QUANTITIES.
Class 2, Lab. 3, cr. 3 (7 A.E.)
Must be preceded by E.E. 316 or 412 or equivalent.

Basic electrical measurements. Measurements of strains, pressures, and other non-electrical quantities by electronic and other devices. Professor LaMothe.

516. INDUSTRIAL ELECTRONIC CONTROL.
Class 2, Lab. 3, cr. 3 (non-E, el.)
Must be preceded by E.E. 316 or 412 or equivalent.

Electronic methods as applied to the control of industrial products and machinery.
Professor Cage and Staff.

523. ADVANCED ELECTRICAL DESIGN I. Class 1, Lab. 6, cr. 3 (el.)
Must be preceded by E.E. 423.

Design problems in insulation, induction motors, and other projects adapted to individual student requirements. Professor Curtner.

525. ADVANCED ALTERNATING-CURRENT MACHINES. Class 3, cr. 3 (el.)
Must be preceded by E.E. 405.

Single-phase motors; variable-speed a-c motors; two-reaction theory and synchronous machines.
Professor Sabbagh.

530. ELECTRIC POWER PLANTS. Class 3, cr. 3 (el.)
Must be preceded or accompanied by E.E. 405.

Factors affecting the location, design, equipment, and operation of modern power plants.
Professor Blalock.

531. ELECTRIC DISTRIBUTION. Class 3, cr. 3 (el.)
Must be preceded or accompanied by E.E. 405.

Electrical engineering principles applied to distribution of electric power. Circuit design and operation. Voltage control and reduction of voltage flicker. Inductive coordination.
Professor Freeman.

534. POWER TRANSMISSION AND DISTRIBUTION I. Class 3, cr. 3 (el.)
Must be preceded or accompanied by E.E. 316 or 405.

Methods and materials used in design and construction of overhead power lines.
Professor Eaton and Staff.

535. POWER TRANSMISSION AND DISTRIBUTION II. Class 3, cr. 3 (el.)
Must be preceded or accompanied by E.E. 405.

Circuit fundamentals as applied to transmission line behavior, inductance and capacitance calculation, characteristics of long lines and four-terminal networks.
Professor Eaton and Staff.

540. COMMUNICATION ENGINEERING I.
SS. Sem. 1 and 2. Class 5, Lab. 3, cr. 6 (el. 7 E)
Must be preceded by E.E. 304 and 307.

R-f amplifiers, oscillators, modulation, demodulation, a-m and f-m transmitters and receivers. Professor R. P. Siskind and Staff.

541. COMMUNICATION ENGINEERING II.
SS. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (el. 8 E)
Must be preceded by E.E. 540.

Sweep and trigger circuits, multivibrators, r-f transmission lines, impedance matching, and wave guides. Professor R. P. Siskind and Staff.

542. COMMUNICATION ENGINEERING III.
SS. Sem. 1 and 2. Class 3, cr. 3 (el. 8 E)
Must be preceded by E.E. 540.

Ultra-high-frequency effects in diodes and triodes, klystrons, and magnetrons, antennas, and wave propagation. Professor R. P. Siskind and Staff.

543. TELEPHONE ENGINEERING I. Sem. 1 and 2. Class 3, cr. 3 (el.)
Must be preceded by E.E. 304.

Sound, speech, hearing, telephone transformers, smooth lines and cables, symmetrical networks, transmitters, receivers, simple telephone circuits.
Professor Cooper.

544. TELEPHONE ENGINEERING II. Sem. 2. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by E.E. 543.

Telephone systems, filters, equalizers, line construction, loaded lines, cross-talk, repeaters, phantom circuits, carrier circuits, long circuit effects.
Professor R. P. Siskind.

530. ADVANCED ELECTRONICS. Class 3, cr. 3

Engineering extension course on electronic theory and tube design.
Professor Hesselberth and Staff.

552. INDUSTRIAL ELECTRONIC CIRCUITS. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by E.E. 307.

Electronic control circuits, rectifiers, inverters, regulators, and resistance welders.
Professor Cage and Staff.

561. ILLUMINATING ENGINEERING. Class 3, cr. 3 (el.)
Must be preceded by E.E. 303.

Lamp characteristics, illumination measurements and calculations, lighting applications and costs.
Mr. Shelley.

562. ILLUMINATION THEORY AND DESIGN. Class 3, cr. 3 (el.)
Must be preceded by E.E. 561.

Factors affecting vision; color theory in illumination design, lighting design for building interiors.
Mr. Shelley.

571. ELECTRICAL TRANSIENTS. Class 3, cr. 3 (el.)
Must be preceded by E.E. 304.

Applications of the classical, operator, and Laplace transform methods in determining equations and wave forms of transient quantities in electrical circuits and machines.
Professor Mueller.

573. DYADICS AND TENSORS. Class 3, cr. 3 (el.)
Must be preceded by E.E. 304.

Algebra of matrices and group transformation theory as applied to analysis and solution of electrical networks.
Professor Oorthuys.

578. SYMMETRICAL COMPONENTS. Class 3, cr. 3 (el.)
Must be preceded by E.E. 304.

Theory and applications; solutions of unbalanced circuits.
Professor Sabbagh and Staff.

583. AUTOMATIC CONTROL MECHANISMS. Class 3, cr. 3 (el.)
Must be preceded by E.E. 307 and 316 or 405.

Fundamental physical and mathematical principles of servo and other automatic control components.
Professor Sabbagh and Staff.

GRADUATE LEVEL

620. ADVANCED ELECTRICAL DESIGN II. Class 3, cr. 3
Must be preceded by E.E. 423.

Design of synchronous machines and a-c equipment.
Professor Curtner.

621. ADVANCED ELECTRICAL DESIGN III. Class 3, cr. 3
Must be preceded by E.E. 423.

Design of single-phase motors and insulators.
Professor Curtner.

625. MODERN THEORIES OF ALTERNATING-CURRENT MACHINES I.
Must be preceded by E.E. 405. Class 3, cr. 3

Fundamental theory of constant—and variable—gap machines, mechanical forces from variable inductances, transients in a-c machines.
Professor Sabbagh.

626. MODERN THEORIES OF ALTERNATING-CURRENT MACHINES II.
Continuation of E.E. 625. Class 3, cr. 3

The vector field theory applied to a-c machines, armature reaction and reactance, energy transfer and stability of machines.
Professor Sabbagh.

630. HIGH-VOLTAGE ENGINEERING I. Class 2, Lab. 3, cr. 3
Must be preceded by E.E. 425 or equivalent.

Fundamentals of high-voltage sources and measurements with particular reference to impulse quantities.
Professor Eaton.

631. HIGH-VOLTAGE ENGINEERING II. Class 2, Lab. 3, cr. 3

Continuation of E.E. 630.

Characteristics of lightning and the protection of equipment from lightning damage. Professor Eaton.

635. POWER SYSTEMS ANALYSIS. Class 2, Lab. 3, cr. 3

Must be preceded by E.E. 425 and 535 and preceded or accompanied by E.E. 578.

General analysis of linear networks as applied to power system calculations; network calculator methods. Professors Eaton and Ward.

636. EQUIVALENT CIRCUIT APPLICATIONS. Class 2, Lab. 3, cr. 3

Must be preceded or accompanied by E.E. 635 and Math. 522.

Types of network analyzers; equivalent electrical circuits in electrical and nonelectrical problems. Professors Eaton and Ward.

640. ADVANCED RADIO ENGINEERING. Sem. 1. Class 2, Lab. 3, cr. 3

Must be preceded by E.E. 540.

Selected topics in radio engineering, including advanced analysis of certain radio circuits, especially those of radio receivers. Professor Cooper.

641. MODULATION AND NOISE. Sem. 2. Class 3, cr. 3

Must be preceded by E.E. 540.

Theoretical analysis of methods of modulation and their utilization of bandwidth and noise-suppressing characteristics. Mathematical study of noise in communication circuits and the limitations imposed thereon by noise. Professor Cooper.

643. PULSE TECHNIQUES. Sem. 2. Class 2, Lab. 3, cr. 3

Must be preceded by E.E. 541.

Fundamental principles underlying such modern applications as radar, loran, television, pulse time modulators, and radio altimeters. Professor Clark.

644. COMMUNICATION NETWORKS I. Sem. 1. Class 2, Lab. 3, cr. 3

Must be preceded by E.E. 540 or 544.

Theory, design, predetermination of performance, and testing of electric wave filters and equalizers. Professor R. P. Siskind.

645. COMMUNICATION NETWORKS II. Sem. 2. Class 2, Lab. 3, cr. 3

Must be preceded by E.E. 644.

Additional network theory with application to feedback amplifier design. Professor R. P. Siskind.

647. WAVES AND WAVE GUIDES. Sem. 1. Class 3, cr. 3

Must be preceded by E.E. 541.

Electromagnetic wave theory, wave guide theory and techniques, cavity resonators. Professor Hayt.

648. ANTENNAS AND WAVE PROPAGATION. Sem. 2. Class 3, cr. 3

Must be preceded by E.E. 541 and preferably E.E. 647.

Antennas, antenna arrays, antenna coupling circuits, electromagnetic horns, radio wave propagation. Professor R. P. Siskind.

649. ELECTRO-ACOUSTICAL ENGINEERING. Sem. 1. Class 2, Lab. 3, cr. 3

Must be preceded by E.E. 540 or 544 or 552.

Microphones, loud speakers, and other electro-mechanical transducers. Theory and applications of these devices. Professor Clark.

650. ADVANCED ELECTRONIC TUBE THEORY. Sem. 2. Class 2, Lab. 3, cr. 3
Must be preceded by E.E. 540 and 552.

Determination of vacuum-tube characteristics as governed by electron action within the tube and by tube design. Engineering applications of the laws of electron behavior in tubes.
Professor Hesselberth.

651. ELECTRONIC INSTRUMENTATION. Sem. 2. Class 3, cr. 3
Must be preceded by E.E. 540 and 552.

An analysis, both theoretical and physical, of the basic circuits used in electronic instruments for the measurement of non-electrical quantities as well as those used in the measurement of purely electrical quantities. Professor Partridge.

652. INDUSTRIAL POWER ELECTRONICS. Sem. 1. Class 2, Lab. 3, cr. 3
Must be preceded by E.E. 307.

Analysis and design of equipment for induction and dielectric heating and other industrial applications.
Professor Cage.

653. ELECTRONICS OF TELEVISION. Sem. 1. Class 2, Lab. 3, cr. 3
Must be preceded by E.E. 540.

Electron optics in kinescopes, image tubes, electron microscopes, and electron multipliers.
Professor Hesselberth.

677. ADVANCED POLYADICS AND TENSORS. Class 3, cr. 3
Must be preceded by E.E. 573.

Applications of polyadics and tensors in engineering problems.
Professor Oorthuys.

680. ELECTRICAL COMPUTERS. Class 3, cr. 3
Must be preceded by E.E. 583 and either E.E. 540 or 552.

Analog representation of electro-mechanical circuits. Simulators. Electronic and mechanical analog computer elements. Solutions of problems by analog computers. Introduction to electrical digital computers. Professors Sabbagh and Burnett.

685. SERVOMECHANISMS. Class 3, cr. 3
Must be preceded by E.E. 583.

Analysis and synthesis of linear servomechanisms. Vector diagrams, transfer functions and their loci as applied to servomechanisms.
Professor Sabbagh.

686. SYNTHESIS OF LINEAR SERVOMECHANISMS. Class 3, cr. 3
Must be preceded by or taken concurrently with E.E. 685.

Complex function and network theory applied to problems in servomechanism design. Root locus design procedures and statistical design theory with emphasis on the application of correlation functions in servomechanism problems.
Professors Sabbagh and Burnett.

687. ADVANCED SERVOMECHANISM THEORY. Class 3, cr. 3
Must be preceded by E.E. 686.

Design techniques for carrier servos and servos with transportation time. Consideration of load-torque disturbances. Analysis of nonlinear servomechanisms and the design of nonlinear components to improve servo performance.
Professors Sabbagh and Burnett.

696. ADVANCED ELECTRICAL ENGINEERING PROJECTS.
Hours and credits to be arranged.
Staff.

698. RESEARCH FOR M.S. THESIS.
Staff.

699. RESEARCH FOR Ph.D. THESIS.
Staff.

GENERAL ENGINEERING

INDUSTRIAL ENGINEERING AND MANAGEMENT, MANUFACTURING PROCESSES, ENGINEERING, DRAWING, AND GENERAL COURSES

Professor Chenea—Acting Head.

Professors: Amrine, Elrod, Knapp, Lascoe, Lindley, Luzadder, Marek, Owen, Porsch, Rising.
Associate Professors: Arnold, Balyeat, Carter, Case, Rogers, H. C. Thompson.
Assistant Professors: Botkin, Eaton, Greene, Kirkpatrick, Mason, Ritchey, Roberts, Sams, Satterly, Thomas, H. Young.
Instructors: Bell, Bolds, Borodavchuk, Brelsford, Carpenter, Cochran, Coddington, Collins, Coster, *Cribbins, Crist, Harding, Hartje, Herman, Hunter, Jacoby, H. M. Kelley, R. D. Kelly, Kessler, Magnusson, McDowell, Mentz, Millgate, Montgomery, Moore, Pertz, Proctor, Radkins, Rees, Renda, Skoran, Smith, Snepp, *Spaid, Stokes, Stolz, E. Taylor, R. Taylor, R. Thompson, Vellinger, Wheelock, *Wilding, Wimmert, W. Young, Yue.
Graduate Assistants: Bock, Carson, Chatto, Kashyap, Poston.
Extension Centers—Instructors: Cleaver, Gallett.

UNDERGRADUATE LEVEL

Lower Division Courses

100. ENGINEERING LECTURES. Sem. 1 and 2. Class 1, cr. 0 (1 Engr.)

To acquaint the freshman engineering students with engineering problems.
Professor Knapp and Engineering Staff.

121. ENGINEERING DRAWING.
SS. Sem. 1 and 2. Class 1, Lab. 4, cr. 2 (1 Engr., II, el.)

Solutions of problems applied to engineering conditions. Emphasis is placed upon orthographic projection, pictorial sketching, and drawings made for reproduction purposes. Problems are designed to require practical reasoning, and the application of graphic methods. Professor Luzadder and Staff.

122. ENGINEERING DRAWING.
SS. Sem. 1 and 2. Class 1, Lab. 4, cr. 2 (2 Engr., 2I, el.)

Continuation of G.E. 121. Developments, dimensioning, shop notes, fasteners, and assembly and detail working drawing. Applications of graphic methods.
Professor H. Thompson and Staff.

125. ELEMENTARY DRAWING. Sem. 1. Class 1, Lab. 4, cr. 2 (op. 1 H., el.)

Lettering, use of drafting instruments, orthographic and pictorial drawing.
Professor Carter.

126. ELEMENTARY ARCHITECTURAL DRAWING.
Sem. 2. Class 1, Lab. 4, cr. 2 (op. 2H, el.)

Must be preceded by G.E. 121 or 125.

Drawing and dimensioning of details, plans and elevations. Professor Carter.

144. SLIDE RULES AND GRAPHS.
Sem. 1 and 2. Class 2, cr. 1 (el. S, 1, 2, 3, 4, Engrs.)

Must be preceded or accompanied by Math. 112 or 141.

Principles and use of the slide rule for division, multiplication, trigonometry, powers and roots. Properties and types of coordinate graphs for scientific and engineering purposes; calculating and plotting graphs: uniform, log, semi-log and others.
Professors Arnold and Botkin.

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* Military leave of absence 1954-55.

151. WELDING, HEAT TREATING AND CASTING LABORATORY.
Sem. 1 and 2. Class 1, Lab. 4, cr. 2 (1 or 2 I, Engr.)
Principles, methods and materials; applications. Professor Lindley and Staff.

161. CASTING AND FORGING DESIGN AND PRACTICE. (3 M)
SS. (2 weeks of summer session between freshman and sophomore years.) Lab. 40, cr. 2
Must be preceded by G.E. 121 and 151 or equivalent.
Casting design for economical production. Study of patterns, core boxes and control equipment in the production of castings as related to economical design. Planning and design of a mold production unit. Principles and methods of forging; design for forging.
Professor Marek and Staff.

176. GENERAL SHOP. Sem. 1 and 2. Lab. 9, cr. 3 (1 I, el.)
Woodwork, general metal work, plastics, finishing. Planning of projects using a variety of materials. Care and use of hand tools and light power machinery.
Professors Sams and Mason.

178. ELEMENTARY WOOD WORKING.
Sem. 1 and 2. Lab. 9, or Class 1, Lab. 6, cr. 3 (2 I, el.)
Must be preceded by G.E. 121 and 176.
Fundamentals of woodworking machines: i.e., saws, jointers, surfacers, mortisers, shapers, tenoners, routers, sanders, lathes. Planning and tooling for quantity production. Care and use of light power and mill-room machinery.
Professors Sams and Mason.

222. DESCRIPTIVE GEOMETRY.
SS. Sem. 1 and 2. Class 1, Lab. 3, cr. 2 (3 Aero, C, Em, M)
Must be preceded by G.E. 122 and Math. 112 or 142.
Relations of points, lines and planes and their graphical and algebraic representations; graphical solutions, and associations with algebraic solutions of theoretical and practical problems.
Professor Elrod and Staff.

227. SHADES, SHADOWS, AND PERSPECTIVE.
Sem. 1. Class 1, Lab. 6, cr. 3 (op. 5 H, el.)
Must be preceded by G.E. 121 or 125 or equivalent.
Graphic representations of shades and shadows on buildings and geometric forms. Parallel and angular perspective. Use of color in rendering. Professor Carter.

229. FREEHAND SKETCHING.
Sem. 1 and 2. Lab. 6, cr. 2 (3I, op. 3 H, el.)
Line sketching in pencil and charcoal of objects as they appear to the eye. Pencil and charcoal shading.
Professor Carter.

230. FREEHAND SKETCHING.
Sem. 1 and 2. Class 1, cr. 1, or Lab. 6, cr. 2 (el.)
Must be preceded by G.E. 229.
Continuation of G.E. 229 including use of color in sketching. Professor Carter.

232. INDUSTRIAL DESIGN. Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el.)
Must be preceded by G.E. 122 and 229.
Principles of art, design, and color harmony, and their application to engineering design. Laboratory problems in designing utilitarian objects and machines for improved appearance.
Professor Carter.

234. FURNITURE AND ART METAL DESIGN.
Sem. 1. Class 1, Lab. 3, cr. 2 (el.)
Must be preceded by G.E. 122 and 229.
Especially for students preparing to teach industrial arts or vocational shop work.
Professor Carter.

251. AIRCRAFT WELDING. SS. Eight weeks, Lab. 3, cr. ⅔ (5 Aero)
Must be preceded by Chem. 101 and G.E. 151.

Welding practices applied to aircraft materials; alloys of steel, aluminum, magnesium, and nickel. Professor Case; Mr. Borodavchuk.

266. AIRCRAFT FABRICATION. Sem. 2. Class 1, Lab. 4, cr. 2⅓ (6 Aero)
Must be preceded by Chem. 101 and preceded or accompanied by G.E. 222.

Care and use of the common aircraft sheet-metal tools and machines, making layouts, templates, riveting, forming and stamping, aircraft materials, and assembly. Mr. Borodavchuk.

275. ELECTRICAL SHOP.
Sem. 1 and 2. Lab. (16 weeks), cr. 2 (3 or 4, E. 2 I)
Must be preceded by G.E. 121 and 151.

Application of hand tools, instruments, and finishing employed in the electrical industry, including laboratory assignments in circuits, electronics, motor maintenance, sheet metal fabrication, and coil winding. Professor Roberts and Staff.

276. ELECTRICITY IN THE HOME. Sem. 2. Class 1, Lab. 6, cr. 3 (4 H)
A shop course for Home Economics majors to familiarize the student with common household electrical problems, with emphasis placed upon the operation, structure, design and care of electrical appliances. Professor Roberts and Staff.

UNDERGRADUATE LEVEL

Upper Division Courses

316. PRODUCTION ILLUSTRATION.
Sem. 2. Lab. 6, or Class 1, Lab. 6, cr. 2 or 3 (el.)
Must be preceded by G.E. 222.

Perspective, detail, sectioned, phantom, and exploded assembly drawings; light and shade, dimensioning, and techniques, all as applied to catalog and production illustration. Professors Elrod and Botkin.

318. ELEMENTS OF ARCHITECTURE.
Sem. 2. Class 2, Lab. 6, cr. 4 (op. 6 H, el.)
Must be preceded by G.E. 227, 229 and 126 or 122.

The classic orders, mouldings, materials, and design. Drawings of the classic orders and elementary design problems. Professor Carter.

321. SPECIAL DRAWING. Sem. 1 and 2. Lab. 3, to Lab. 9, cr. 1 to 3 (el.)
May be rescheduled for 3 hours additional credit.
Prerequisites dependent upon nature of problem. G.E. 122 is usually sufficient.

Problems selected to suit needs of students. Professors Carter and Rising.

325. DRAWING TEACHING PRACTICE.
Sem. 1 and 2, Class 1, Lab. 4, cr. 3 (el.)
Must be preceded by G.E. 122.

Assignment to assist with laboratory work in G.E. 121 classes. Seminar meetings and papers on objectives, content, methods, and testing in engineering drawing. Professor Rogers.

326. DRAWING TEACHING PRACTICE.
Sem. 2. Class 1, Lab. 4, cr. 3 (el.)
Must be preceded by G.E. 222 and 325.

Assignment to assist with the laboratory work in G.E. 122 classes. Interviews and papers on objectives, content and the development of laboratory and test problems in engineering drawing. Professor Rogers.

336. AIRCRAFT WELDING AND MATERIALS.
Sem. 1 and 2. Lab. 5, cr. 2 (5 AT)
Must be preceded by Chem. 101, G.E. 122 and 151.
Welding practices applied to aircraft materials; alloys of steel, aluminum, magnesium and nickel.
Professor Case; Mr. Borodavchuk.

345. MACHINE TOOLS.
SS. Sem. 1 and 2. Lab. 6, cr. 2 (3 I, 5 or 6 M, 3 or 4 E, 5 AE)
Must be preceded by G.E. 122 and 151.
Fundamentals of machine tool operations, set-ups, and metal cutting; laboratory assignments. Machineability of various metals; general purpose and production tools. Applications of jigs, fixtures, inspection techniques, and tooling for production.
Professor Lascoe and Staff.

347. AIRCRAFT FABRICATION.
Sem. 1 and 2. Class 2, Lab. 5, cr. 3 (5 AT)
Must be preceded by Chem. 101 and G.E. 122 and 151.
Aircraft fabrication practices, application and use of hand and machine sheet metal tools, preparation, forming, fastening, and assembly of various airframe materials.
Mr. Borodavchuk.

350. ARTS AND CRAFTS. Sem. 2. Class 1, Lab. 6, cr. 3 (5, 6, 7, 8 P.E.M.)
An introduction to arts and crafts work for recreation leaders.
Professors Sams and Mason.

351. ELECTRICAL SHOP FOR TEACHERS.
Sem. 1. Class 1, Lab. 6, cr. 3 (6, 7 I)
Must be preceded by G.E. 122, 275, 176.
A course in the teaching of electricity in the general or unit shop. Design and construction of demonstration materials and development of presentation techniques.
Professor Roberts and Staff.

353. CABINET WORK AND PATTERN MAKING.
Sem. 2. Class 1, Lab. 6, cr. 3 (6, 7 I)
Must be preceded by G.E. 122, 161, 178.
Design and construction of furniture and cabinets. Basic principles of pattern making.
Professors Sams and Mason.

355. SHEET METAL WORK. Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el. I)
Must be preceded by G.E. 122 and 176.
Fundamental practices applied to sheet metal, hand tools, and machines. Planning and developing sheet metal layouts and templates. Fabrication of light gauge metals.
Mr. Borodavchuk.

361. SHOP PROBLEMS. Sem. 1 and 2. Class 3, cr. 3
Must be preceded by Math. 141 and 142 and by G.E. 345.
Analysis of problems and mechanisms especially related to shop processes.
Professor Lascoe.

362. PLANT AND SHOP MAINTENANCE.
Sem. 1 or 2. Class 2, Lab. 3, or Class 3, cr. 3 (4 I)
Must be preceded by Educ. 467, G.E. 345, 178, 176.
Maintenance of shop equipment and physical plant; planning and organizing for preventive maintenance.
Professor Lascoe and Staff.

363. INDUSTRIAL SAFETY. Sem. 1. Class 3, cr. 3 (4 I, op. 7, 8 PE, el.)
Must be preceded by G.E. 345, 275, 176.
Safety methods in industry. Safety codes, compensation, inspection, safety educational program, industrial facilities to care for injured workmen, health hazards and protective measures, safeguards on equipment and buildings to prevent accidents.
Professor Owen and Mr. Vellinger.

365. INDUSTRIAL ORGANIZATION AND MANAGEMENT.
Sem. 1 and 2. Class 3, cr. 3 (5, 6 M, 7 Aero, el.)
Students must have at least junior standing.

Basic course in principles of organization and management. Introduces the functions of plant layout, production planning and control, quality control, motion and time study, industrial relations, accounting and sales. Professor Ritchey and Staff.

370. ELEMENTS OF ACCOUNTING I. Now offered as Econ. 370.

371. ELEMENTS OF ACCOUNTING II. Now Offered as Econ. 371.

428. ARCHITECTURAL DESIGN. Sem. 1. Lab. 6, cr. 2 (op. 7 H, el.)
Must be preceded by G.E. 318.

Study and design of home plans. Professor Carter.

430. DESIGN OF DOMESTIC RESIDENCES.
Sem. 2. Lab, 6, cr. 2 (8 H, el.)
Must be preceded by G.E. 428 and M.E. 316.

Design problems, working drawings and specifications for domestic residences. Professor Carter.

443. WELDING FOR TEACHERS.
Sem. 1 and 2. Class 2, Lab. 4, cr. 3 (el.)
Approval of instructor is required.
Must be preceded by G.E. 122 and G.E. 151 or equivalent.
Mr. Cochran and Staff.

444. WELDING TEACHING PRACTICE.
Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el.)
Continuation of G.E. 443. Mr. Cochran and Staff.

460. OCCUPATIONAL PRACTICES AND RELATED CONTENT INFORMATION.
cr. 1 to 6
Must be preceded by sufficient trade or occupational experience to meet Smith-Hughes or George-Barden licensing requirements.

Trade or occupational information of a specific and related nature essential in the teaching of the major specialty. Adequate attainment of standards indicates trade competency. Available only to certain students in the Industrial Education curriculum. Staff.

461. OCCUPATIONAL PRACTICES AND RELATED CONTENT INFORMATION.
cr. 1 to 6
Continuation of G.E. 460. Staff.

462. OCCUPATIONAL PRACTICES AND RELATED CONTENT INFORMATION.
cr. 1 to 6
Must be preceded by G.E. 460 and 461.

Continuation of G.E. 460 and 461, Adequate attainment of standards indicates trade excellence of a definitely superior character. Available only to certain students in the Industrial Education curriculum. Staff.

463. OCCUPATIONAL PRACTICES AND RELATED CONTENT INFORMATION.
cr. 1 to 6
Continuation of G.E. 462. Staff.

469. INDUSTRIAL SALES. Sem. 1 and 2. Class 3, cr. 3 (el. 6, 7, 8)
Students must have at least junior standing in Engineering or consent of the instructor.

The relation and application of engineering to the selling of technical products. The principles and problems of sales management; including planning, promotion, organization and control of sales. Professor Ritchey.

499. RESEARCH IN GENERAL ENGINEERING. Sem. 1 and 2. (el.)
Hours and credit to be arranged with approval of the head of the department.
Professor Chenea and Staff.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

501. PROJECTS IN AUDIO-VISUAL AIDS.

Sem. 1 and 2, and SS. 1. Class 2, Lab. 3, cr. 3 (8 I, el.)

May be rescheduled for 3 hours additional credit. May be offered as an intensive course. Must be preceded by Chem. 101 or G.E. 121. Approval of instructor is required.

Design, construction, and use of models, lantern slides, motion pictures, and other audio-visual materials for specific purposes. Problems are assigned to suit students specific interests. Professor Rising.

522. ADVANCED DESCRIPTIVE GEOMETRY.

Sem. 2. Class 1, Lab. 3, or Class 1, Lab. 6, cr. 2 or 3 (el. 5, 6, 7, 8)

Must be preceded by G.E. 222.

Graphical and algebraic representation and applications of plane and space curves, single and double curved surfaces, and warped surfaces; fundamentals of perspective and other pictorial means of representation. Professors Elrod and Porsch.

532. NOMOGRAPHIC DRAWING. Sem. 2. Class 2, Lab. 3, cr. 3 (el.)

Must be preceded by G.E. 122 and Math. 142 or 111, and 221.

Graphical presentation of data; theory and construction of alignment charts and special slide rules; determination of equation to represent empirical data. Professor Arnold.

541. PRODUCTION WELDING. Sem. 1 or 2. Class 1, Lab. 6, cr. 3 (el.)

Approval of instructor is required.

Must be preceded by G.E. 161 and Met.E. 345 or equivalent.

Production welding processes and equipment; use of jigs and fixtures; applications to both commonly used and special metals. Professor Case and Staff.

546. FOUNDRY CONTROL METHODS.

Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el.)

Must be preceded by G.E. 161 and Met.E. 345 or equivalent.

Sand control; cause and elimination of casting defects; construction, maintenance, and operation of melting furnaces; control methods. Professor Marek.

547. FOUNDRY ENGINEERING PROBLEMS.

Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el.)

Must be preceded by G.E. 546.

Investigation of foundry engineering problems. Laboratory work to accompany investigation. Discussion of problems in seminar. Professor Marek.

551. TOOLING FOR PRODUCTION.

Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el.)

Approval of the instructor is required. Must be preceded by G.E. 345.

Continuation of G.E. 345, involving more advanced methods in production.

Planning and machining pilot models for production. Jigs, fixtures, and dies. Use and application of production mills, gear cutters, stamping and forming, broaching, and profile and duplicating tools. Professor Lascoe and Staff.

552. PRODUCTION MACHINE TOOLS.

Sem. 2. Class 1, Lab. 6, cr. 3 (el.)

Must be preceded by G.E. 345. Approval of the instructor is required.

Tool applications with special reference to screw machines and turret lathes, stamping and forming machines; quality control applied to inspection.

Professor Lascoe and Staff.

556. WORKSHOP FOR GENERAL SHOP TEACHERS.
SS. Lab. 40, cr. 1 to 4 (one credit per week)
Must be preceded by G.E. 122, G.E. 176 and Educ. 467 or equivalent.

Advanced and practical ideas and methods of teaching high-school general-shop courses. Students will participate actively in general-shop exercises.
Professor Roberts and Staff.

557. PRODUCTION WOODWORKING.
Sem. 1 or 2. Class 1, Lab. 6, cr. 3 (el.)
Must be preceded by G.E. 178 or equivalent.

Continuation of G.E. 178 involving advanced methods for production of wood products.
Professors Sams and Mason.

570. COST ACCOUNTING. Now offered as Econ. 570.

571. COST ACCOUNTING. Now offered as Econ. 571.

575. MOTION AND TIME STUDY.
Sem. 1 and 2. Class 3, cr. 3 (op. 5 M, el.)
Students must have at least junior standing. Not available for graduate credit toward advanced degrees in Industrial Engineering and Management.

Principles and techniques of motion study, engineering job methods, human factors affecting job methods, time study, predetermined time systems, ratio-delay, human and economic aspects of motion and time study. Professor Amrine and Staff.

576. ADVANCED MOTION AND TIME STUDY.
Sem. 1 and 2. Class 3, cr. 3 (el.)
Must be preceded by G.E. 575.

Formulation of industrial policies for the application of motion and time study. Practice in construction of standard data; ratio-delay studies; predetermined time standards. Practice in methods application. Professor Amrine.

578. PRODUCTION PLANNING AND CONTROL.
Sem. 1 and 2. Class 3, cr. 3 (op. 6, 7 M, el.)
Must be preceded by G.E. 345, 161, 365, 575, not available for graduate credit toward advanced degrees in Industrial Engineering and Management.

The basic concepts, principles, objectives and functions involved in the design of manufacturing processes and control of production in industry. Economic aspects of manufacturing procedures. Professor Greene and Mr. Wimmert.

579. ADVANCED PRODUCTION CONTROL.
Sem. 1 and 2. Class 3, cr. 3 (el.)
Must be preceded by G.E. 578.

Analysis and synthesis of production control in industry. Procedure analysis and design.
Professor Greene.

581. TOOL DESIGN. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (op. 8 M, el.)
Must be preceded by G.E. 578 and M.E. 470 or 371.

Fundamental principles of tool design with specific reference to the design of tools for the basic manufacturing processes. Professor H. Young.

583. PLANT LAYOUT. Sem. 2. Class 2, Lab. 3, cr. 3 (el.)
Must be preceded by Econ. 570 and G.E. 578.

Design of a manufacturing plant; to include all factors affecting the layout of factory grounds, buildings, equipment and facilities. Professor Young.

585. INDUSTRIAL RELATIONS. Sem. 1 and 2. Class 3, cr. 3 (op. 6 M, el.)
Must be preceded by G.E. 365.

Personnel management functions of job analysis, selection and placement, training, wage and hour administration, and employee services; introduction to collective bargaining.
Professors Balyeat and Ritchey.

586. LABOR RELATIONS. Sem. 1 and 2. Class 3, cr. 3 (el.)
Must be preceded by G.E. 585.
Labor-management relationships and the problems of collective bargaining.
Professor Balyeat.

587. WAGE ADMINISTRATION. Sem. 1. Class 3, cr. 3
Must be preceded by G.E. 575 and 585 or equivalent.
Job analysis, job evaluation, merit rating and wage payment plans.
Professor Balyeat.

590. PROJECTS IN INDUSTRIAL ENGINEERING. cr. 1 to 6 (el.)
Must be preceded by twelve credit hours of industrial engineering and related courses and approval of instructor concerned.
Supervised individual project course. Research on special problems or projects in management.
Professor Amrine and Staff.

594. PROJECTS IN GRAPHICS.
Sem. 1 and 2. Cr. 1 to 6, hours to be arranged. (el.)
Must be preceded by G.E. 222 and G.E. 227 or 316 or equivalent.
Directed work on individual problems and research in graphical computation and representation.
Professor Porsch and Staff.

595. PROJECTS IN MANUFACTURING PROCESSES. Sem. 1 and 2. (el.)
Hours and credit to be arranged with approval of the chairman of the Manufacturing Processes section.
Professor Lindley and Staff.

GRADUATE LEVEL

601. ENGINEERING EDUCATION. Class 3, cr. 3
For graduate engineering students only.
History of engineering education; engineering curricula and methods of teaching in the engineering colleges in the U. S. A. and in foreign countries; engineering education and industry; cost of engineering education.

602. ENGINEERING EDUCATION. Class 3, cr. 3
Continuation of G.E. 601.

655. SEMINAR IN INDUSTRIAL MANAGEMENT. Sem. 2. Class 3, cr. 3
Must be preceded by Econ. 570, G.E. 575 and 585. Consideration of the current trends and advanced problems in the organization and management of manufacturing enterprises.
Professor Ritchey.

683. MECHANIZATION AND AUTOMATIC CONTROL.
Sem. 1. Class 2, Lab. 3, cr. 3
Must be preceded by G.E. 581 and 583. Mechanization of materials handling and industrial processes; application of mechanisms and servomechanisms for automatic control of equipment; design for mechanized production. Professor H. Young.

690. ADVANCED PRODUCTION PROBLEMS. cr. 3 to 5
Must be preceded by G.E. 583.
Advanced industrial engineering course for graduate students who have had the basic courses in industrial engineering and who are capable of superior independent investigation under direction.
Professor Amrine and Staff.

691. ADVANCED PRODUCTION PROBLEMS. cr. 3 to 5
Continuation of G.E. 690.
Professor Amrine and Staff.

692. ADVANCED INDUSTRIAL ENGINEERING PROBLEMS. cr. 3 to 5
Must be preceded by 15 credit hours of basic industrial engineering courses.
Investigation of specific management problems in organization, time and motion study, factory layout, economic selection of equipment, and similar topics.
Professor Amrine and Staff.

693. ADVANCED INDUSTRIAL ENGINEERING PROBLEMS. cr. 3 to 5
Continuation of G.E. 692.
Professor Amrine and Staff.

694. RESEARCH IN INDUSTRIAL RELATIONS. cr. 3 to 6
Must be preceded by G.E. 586.
Research in personnel and industrial relations. Professor Balyeat and Staff.

698. RESEARCH IN INDUSTRIAL ENGINEERING (M.S. THESIS.)
Professor Amrine and Staff.

MECHANICAL ENGINEERING

Professor Solberg in charge.

Professors: Agnew, Ault, Binder, Clark, *Eaton, Hall, Hawkins, Messersmith, Miller, Quinn, Sibbitt, Spalding, Stitz, Zucrow.

Associate Professors: Azpell, Bergren, Brock, Brown, Cromer, Fontaine, Holowenko, Jones, Touloukian, Warner, Witzell.

Assistant Professors: Bogardus, Coughlin, Geiger, Grosh, Laughlin, Lusk, Morse, Olsen, Reese, Van Camp.

Instructors: Allen, Cohen, Comparin, Dunk, Goulard, Greenberg, Hayworth, Jefferson, Osborn, Regenbrecht, Rezek, Robison, Schoenberger, Stene, Wellman, Wolf.

Extension Centers—Instructors: Herrmann, Horner, Krebs, Shimmin.

Engineering Experiment Station—Research Assistants: Bergdolt, Botje, Bottorf, Diamond, Elliott, Graham, Moore, Sellers, Smith.

UNDERGRADUATE LEVEL

Lower Division Courses

206. GENERAL THERMODYNAMICS I.
Sem. 2. Class 3, cr. 3 (4 Aero, E.S.)
Must be preceded by Math. 242.
First and second law, kinetic theory; applications to properties of gases, liquids and solids. Analysis of several types of systems. Heat transmission. Professor Brown.

230. ELEMENTARY HEAT POWER.
SS. Sem. 1 and 2. Class 3, cr. 3 (4 Aero, M, E.S.; 5 AgE, 7 E)
Must be preceded by Phys. 220 or 240 and Math. 241.
Matter and energy, fuels and combustion, internal combustion engines, steam generation, turbines, heat exchangers, fans and pumps. Professor Coughlin.

231. ELEMENTARY HEAT POWER AND THERMODYNAMICS.
Sem. 2. Class 3, cr. 4½ (4 Aero, M)
For students having a cumulative index of 4.8 or better.
Optional course covering M.E. 230 and the first half of M.E. 300 in one semester. Professor Jones.

280. MECHANICAL ENGINEERING EQUIPMENT LABORATORY.
SS. Lab. 40, cr. 2 (M)
(Two weeks of summer session between freshman and sophomore years.)
Construction and function of automobile engines; power transmission devices, lubricating systems, pumps, turbines, and piping. Professor Messersmith.

281. MECHANICAL ENGINEERING LECTURES.
Sem. 1 and 2. Class 2, cr. ⅔ (3 M)
Survey of the field of mechanical engineering. Professor Clark and Staff.

285. INDUSTRIAL PRACTICE I. SS. Sem. 1 and 2. cr. 0
For cooperative program students only.
Must be preceded by G.E. 151, G.E. 161 and M.E. 280.
Practice in industry and comprehensive written reports of this practice.

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* Formosa-Purdue Engineering Project.

286. INDUSTRIAL PRACTICE II. SS. Sem. 1 and 2. cr. 0
For cooperative program students only.
Must be preceded by M.E. 285.

Practice in industry and comprehensive written reports of this practice.

287. INDUSTRIAL PRACTICE III. SS. Sem. 1 and 2. cr. 0
For cooperative program students only.
Must be preceded by M.E. 286.

Practice in industry and comprehensive written reports of this practice.

288. INDUSTRIAL PRACTICE IV. SS. Sem. 1 and 2. cr. 0
For cooperative program students only.
Must be preceded by M.E. 287.

Practice in industry and comprehensive written reports of this practice.

289. INDUSTRIAL PRACTICE V. SS. Sem. 1 and 2. cr. 0
For cooperative program students only.
Must be preceded by M.E. 288.

Practice in industry and comprehensive written reports of this practice.

UNDERGRADUATE LEVEL

Upper Division Courses

300. THERMODYNAMICS. SS. Sem. 1 and 2. Class 3, cr. 3 (5 M)
Must be preceded by M.E. 230, Math. 242 and M.E. 280.

First law, properties of pure substances, second law, entropy, gas and gas-vapor mixtures.
Professor Jones.

301. THERMODYNAMICS. SS. Sem. 1 and 2. Class 3, cr. 3 (6 M)

Continuation of M.E. 300. Combustion, gas and vapor power cycles, compressors, refrigeration, heat transfer.
Professor Jones.

303. THERMODYNAMICS. Sem. 1. Class 3, cr. 4½ (5 M)
For students having a cumulative index of 4.8 or better.

Optional course covering the second half of M.E. 300 and M.E. 301 in one semester.
Professor Jones.

306. GENERAL THERMODYNAMICS II.
Sem. 1. Class 3, cr. 3 (5 Aero, E.S.)
Must be preceded by M.E. 206.

Continuation of M.E. 206.
Professor Brown.

307. ELEMENTS OF THERMODYNAMICS.
SS. Sem. 1 and 2. Class 3, cr. 3 (5 Aero, 6 AgE, 8 E)
Must be preceded by credit in Math. 242 and M.E. 230.

Thermodynamics of gases and vapors; application to internal combustion engines, compressors, vapor cycles, refrigeration, and flow of fluids.
Professor Brown.

310. FLUID MECHANICS.
SS. Sem. 1 and 2. Class 3, Lab. 2, cr. 3⅔ (5 Aero, E.S.; 6 M; 7 AgE)
Must be preceded by E.S. 204 and preceded or accompanied by M.E. 300 or M.E. 307.

Physical properties; statics; viscous flow; dimensional analysis; dynamic similarity; incompressible flow; fluid meters; momentum; resistance; lift; compressible flow; fluid machinery.
Professor Binder.

316. DOMESTIC HEATING AND AIR-CONDITIONING.
Sem. 2. Class 3, cr. 3 (op. H)
Must be preceded by Phys. 200.

Domestic requirements for heating, sanitary plumbing, water heating, and insulation. Field inspection of houses under construction.
Professor Morse.

344. MECHANICAL ENGINEERING LABORATORY.

Sem. 1 and 2. Class 1, Lab. 3, cr. 2 (5 or 6 M)

Must be preceded by M.E. 230 and 280.

Instruments; centrifugal pumps; fans; internal combustion engines.

Professor Messersmith.

360. MECHANISM. SS. Sem, 1 and 2. Class 2, Lab. 3, cr. 3 (5 M, Aero)

Must be preceded by E.S. 204 and M.E. 280.

Motions and velocities of machine parts. Professors Ault and Bergren.

363. MECHANISM AND DYNAMICS OF MACHINERY.

Sem. 1. Class 3, Lab. 3, cr. 4½ (5 M)

Must be preceded by credit in E.S. 204 and M.E. 280.

For students having a cumulative index of 4.8 or better.

Optional course covering M.E. 360 and the first half of M.E. 366 in one semester.

Professor Ault.

366. DYNAMICS OF MACHINERY.

SS. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (6 M)

Must be preceded by M.E, 360 and E.S. 204.

Velocities, accelerations, working and inertia forces in machine parts. Deflections and critical speeds of shafts. Professors Ault and Lusk.

371. MACHINE DESIGN.

SS. Sem. 1 and 2. Class 2, Lab. 3, cr. 3 (6 M, 7 Aero)

Must be preceded by M.E. 360 and E.S. 312.

Theory applied to machine parts. Professors Ault and Azpell.

MECHANICAL ENGINEERING BUILDING

444. MECHANICAL ENGINEERING LABORATORY.

Sem. 1 and 2. Class 1, Lab. 3, cr. 2 (7 M)

Must be preceded by M.E. 301 and 344.

Steam-driven prime movers; heat transfer; flow meters; refrigeration; steam generators. Professor Messersmith.

446. MECHANICAL ENGINEERING LABORATORY.

Sem. 1 and 2. Class 1, Lab. 3, cr. 2 (8 M)

Must be preceded by M.E. 344 and preceded or accompanied by M.E. 301.

Steam-driven prime movers; flow meters; fuel calorimetry; refrigeration; steam generators. Professor Messersmith.

463. DYNAMICS OF MACHINERY AND MACHINE DESIGN.
Sem. 2. Class 3, Lab. 6, cr. 6½ (6 M)
Must be preceded by credit in M.E. 363 and E.S. 312.
For students having a cumulative index of 4.8 or better.

Optional course covering the second half of M.E. 366 and M.E. 470 in one semester.
Professor Ault.

470. MACHINE DESIGN. SS. Sem. 1 and 2. Class 3, Lab. 6, cr. 5 (7 M)
Must be preceded by M.E. 366 and E.S. 312.

Proportioning of machine parts according to the laws of mechanics, with attention to function, production, and economic factors; design of a machine.
Professors Ault and Holowenko.

479. APPLICATIONS OF EXPERIMENTAL STRESS ANALYSIS.
Sem. 2. Class 2, Lab. 3, cr. 3 (tech. el. 8 M)
Must be preceded by E.S. 312 or 313.

Introduction to techniques of analysis of stresses, strains, and friction by experimental means. Same as E.S. 479.
Professor Stitz.

485. ENGINEERING ADMINISTRATION.
Sem. 1 and 2. Class 3, cr. 3 (8 M)
(For seniors only.)

Engineering economy; contracts and specifications; law; professional relations; ethics.
Professors Clark, Miller and Brown.

499. RESEARCH IN MECHANICAL ENGINEERING.
Sem. 1 and 2. cr. 3 (tech. el. 8 M)

Available upon arrangement with the head of the school.
Staff.

DUAL LEVEL—UNDERGRADUATE AND GRADUATE

500. THERMODYNAMICS. Sem. 1 and 2. Class 3, cr. 3 (tech. el. 8 M)
Must be preceded by M.E. 301.

A more extended treatment of the fundamentals of thermodynamics, including equilibrium, combustion, and real gases.
Professor Witzell.

505. HEAT TRANSMISSION.
SS. Sem. 1 and 2. Class 3, cr. 3 (tech. el. 7, 8, M, ChE)
Must be preceded by M.E. 301 or 307.

Fundamental principles of heat transmission by radiation, conduction, and convection; application of these principles to the solution of engineering problems.
Professor Van Camp.

510. FLUID DYNAMICS AND MACHINERY.
Sem. 1 and 2. Class 3, cr. 3 (tech. el. 7, 8 M)
Must be preceded by M.E. 310.

Steady and unsteady flow of compressible and incompressible fluids; principles of operation of fluid dynamical machines such as centrifugal and axial-flow fans, pumps, compressors, fluid couplings, and torque converters.
Professor Binder.

516. HEATING, VENTILATING, AND AIR-CONDITIONING.
SS. Sem. 1 and 2. Class 3, cr. 3 (tech. el. 7, 8 M)
Must be preceded by M.E. 301.

Heating and cooling for comfort; design of several types of domestic heating systems; particular emphasis upon practical applications.
Professors Miller and Morse.

517. COMMERCIAL HEATING, VENTILATING AND AIR-CONDITIONING.
Sem. 2. Class 2, Lab. 3, cr. 3 (tech. el. 8 M)
Must be preceded by M.E. 516.

Commercial application of heating, ventilating, and air-conditioning; drying, district heating; other industrial applications; field inspections and trouble correction.
Professor Miller.

518. HEATING, VENTILATING, AND AIR-CONDITIONING DESIGN. Sem. 2. Class 1, Lab. 6, cr. 3 (tech. el. 8 M)

Must be preceded by M.E. 516.

Design of warm-air, steam, and hot-water heating systems. Determination of cooling requirements, selection of equipment, writing of specifications, and design of air-duct systems. Professor Morse.

521. REFRIGERATION. Sem. 1 and 2. Class 3, cr. 3 (tech. el. 7, 8 M)

Must be preceded by M.E. 301.

Refrigerants; estimation of loads; selection and operation of motors, compressors, condensers, coolers, evaporators, and controls. Professor Fontaine.

522. REFRIGERATION. Sem. 2. Class 2, Lab. 3, cr. 3 (tech. el. 8 M)

Must be preceded by M.E. 521.

More complex refrigeration systems; economical plant design; air-conditioning applications; reports on current articles. Professor Fontaine.

525. COMBUSTION. Sem. 1. Class 3, cr. 3 (tech. el. 7, 8 M)

Must be preceded by M.E. 301 and 310.

Characteristics of fuel-air mixtures; ignition; flame propagation; diffusion flames; premixed flames; explosion and detonation. Professor Agnew.

530. POWER PLANT ENGINEERING. Sem. 2. Class 3, cr. 3 (tech. el. 8 M)

Must be preceded by M.E. 301.

Power plant economics; selection and performance of steam-generating equipment, prime movers and condensers; heat balance studies. Professor Spalding.

533. STEAM AND GAS TURBINES. Sem. 1. Class 3, cr. 3 (tech. el. 7 M)

Must be preceded by M.E. 301.

Analysis and design of nozzles, blades, and other components of steam and gas turbines; cycles. Professor Reese.

540. INTERNAL COMBUSTION ENGINES. Sem. 1 and 2. Class 3, cr. 3 (tech. el. 7 M)

Must be preceded by M.E. 301.

Basic principles; theoretical and actual cycles; performance characteristics; combustion; carburetion; cooling; supercharging; fuels and lubricants; accessories and controls. Professor Cromer.

541. OIL AND DIESEL ENGINES. Sem. 1 and 2. Class 3, cr. 3 (tech. el M)

Must be preceded by M.E. 540.

The modern oil engine and its application; injection; combustion; combustion chambers; performance; costs, etc. Professor Cromer.

544. INTERNAL COMBUSTION ENGINE LABORATORY. Sem. 1 and 2. Class 1, Lab. 6, cr. 3 (el. M)

Must be preceded by M.E. 540. Limited to students approved by the instructor.

Performance testing of spark and compression ignition engines and component assemblies; knock rating of gasoline and diesel fuels. Professor Cromer.

545. AUTOMOTIVE ENGINEERING. Sem. 2. Class 3, cr. 3 (tech. el. 8 M)

Must be preceded by M.E. 540 and M.E. 470.

Automotive equipment, performance factors, a special study of the chassis units used in motive vehicles. Professor Cromer.

551. GAS TURBINE AND JET-ENGINE POWER PLANTS. Class 3, cr. 3 (tech. el. 8 M)

Must be preceded by M.E. 301 and 310.

Basic principles and analysis of performance characteristics of the turbo-prop, turbo-jet, and rocket propulsion systems. Aerodynamic and thermodynamic analysis of flow through engine components, ducts, nozzles, etc. Professor Reese.

560. KINEMATICS. Sem. 1. Class 3, cr. 3 (tech. el. 7, 8 M)
Must be preceded by M.E. 366.

Geometry of constrained motion, with applications to point paths; kinematic synthesis; types of mechanisms.
Professor Hall.

562. MECHANICAL VIBRATIONS.
Sem. 2. Class 2, Lab. 3, cr. 3 (tech. el. 8 M)
Must be preceded by E.S. 312 and M.E. 366.

Credit will not be given for both M.E. 562 and E.S. 562.

Fundamentals of vibrations and application to simple machine and structural members; laboratory demonstrating practical analysis. Professor Quinn.

566. MECHANICS OF MACHINERY. Sem. 1. Class 3, cr. 3 (tech. el. 7, 8 M)
Must be preceded by M.E. 366.

Turning-effort diagrams; flywheel analysis; balancing; firing order; vibration; pin-pressure diagrams; stresses due to inertia forces; stresses in rotating discs; gyroscopes.
Professor Holowenko.

567. DYNAMICAL PROBLEMS IN MACHINE DESIGN.
Sem. 1. Class 3, cr. 3 (tech. el. 7, 8 M)
Must be preceded by M.E. 366.

Methods for determining dynamic characteristics of mechanisms. Designs of devices for specific velocities and accelerations under given force systems.
Professor Quinn.

570. MACHINE DESIGN. Sem. 2. Class 2, Lab. 3, cr. 3 (tech. el. 8 M)
Must be preceded by M.E. 371 or 470.

Analysis of stresses and deflections due to complicated loadings; investigation of specific problems to illustrate methods of analysis and development of solution; individual design on an original project.
Professor Ault.

GRADUATE LEVEL

600. ADVANCED THERMODYNAMICS. Sem. 1. cr. 3
Must be preceded by M.E. 500 and Math. 421.

Availability and irreversibility; thermodynamics of stationary states; general relationships; kinetic theory; virial equations of state; thermodynamic and transport properties of gases and gas mixtures.
Professor Touloukian.

601. ADVANCED THERMODYNAMICS. Sem. 1 and 2. cr. 1 to 9
Must be preceded by M.E. 600.

Continuation of M.E. 600 on a conference basis. Advanced study of various concepts of thermodynamics as applied to the analysis of engineering systems.
Professor Touloukian.

605. ADVANCED HEAT TRANSMISSION. Sem. 1 and 2. cr. 3
Must be preceded by M.E. 505 and Math. 421.

Physical properties; conduction in simple bodies; convection with and without phase changes; radiation in simple systems; luminous and nonluminous gaseous radiation; applications.
Professor Grosh.

606. ADVANCED HEAT TRANSMISSION. SS. Sem. 2. cr. 1 to 9
Must be preceded by M.E. 605.

Continuation of M.E. 605 on a conference basis. Advanced study and design problems on one or more phases of theory and application. Professor Grosh.

610. ADVANCED FLUID DYNAMICS. Sem. 2. cr. 3
Must be preceded by M.E. 510.

Incompressible and compressible flow; turbulence; boundary layer flow; unsteady flow; fluid vibrations; fluid dynamical machinery.
Professor Binder.

611. ADVANCED FLUID DYNAMICS. Sem. 1 and 2. cr. 1 to 9
Must be preceded by M.E. 510. Normally preceded by M.E. 610.
Conference course permitting latitude in choice of topics. Professor Binder.

615. MASS TRANSFER. Sem. 2. cr. 3
Must be preceded by M.E. 500, M.E. 505, and Math. 421.
Steady-state and transient transfer of mass by diffusion and turbulence; analogy between mass transfer and heat transfer; application of theory to mass transfer apparatus. Professor Touloukian.

616. LOW TEMPERATURE THERMODYNAMICS. Sem. 2. cr. 3
Must be preceded by M.E. 500, M.E. 505, and Math. 421.
Analysis of thermodynamic cycles as applied to refrigeration; gas liquefaction and separation; binary systems; absorption systems; properties of matter for low temperature heat transfer. Professor Touloukian.

630. ADVANCED POWER ENGINEERING. Sem. 2. cr. 3
Must be preceded by M.E. 500 and M.E. 530.
Design and operation of steam-electric, gas-electric, and hydroelectric power plants. Professor Solberg.

640. ADVANCED INTERNAL COMBUSTION ENGINES. Sem. 1. cr. 3
Must be preceded by M.E. 540.
Combustion processes; mechanism of detonation and pre-ignition; carburetion and mass distribution of mixtures; losses; cooling requirements; ignition; fuels and lubricants; performance factors and estimates. Professor Cromer.

645. ADVANCED AUTOMOTIVE ENGINEERING. Sem. 2. cr. 2 to 6
Must be preceded by M.E. 545.
Conference course on selected subjects of interest to the student. Professor Cromer.

650. GAS TURBINES AND JET PROPULSION. Sem. 1. cr. 3
Must be preceded or accompanied by M.E. 500 and 510.
Thermodynamics and one-dimensional dynamics of high-speed flow; thermodynamic properties of air; performance analysis of jet-propelled aircraft; propeller characteristics. Professor Zucrow.

651. GAS TURBINES AND JET PROPULSION. Sem. 2. cr. 3
Must be preceded by M.E. 650.
The gas-turbine powerplant, turbo-jet engine, ram jet, pulse jet, and rocket; characteristics of turbines and compressors; combustion and combustion chambers; high-temperature metallurgy. Professor Zucrow.

652. FUNDAMENTALS OF ROCKETRY. Sem. 2. cr. 3
Must be preceded by M.E. 500 and M.E. 650.
Interior ballistics of solid- and liquid-propellant rocket motors; application of thermodynamics and fluid mechanics to flow of propellant gases; calculation of specific impulse; heat transfer; external ballistics. Professors Zucrow and Warner.

660. ADVANCED KINEMATICS. Sem. 2. cr. 2 to 6
Must be preceded by M.E. 560. Some reading knowledge of German desirable.
Extended study of geometry of constrained motion in two and three dimensions; applications to the design of mechanisms. Professor Hall.

662. ADVANCED VIBRATION PROBLEMS. cr. 2 to 6
Must be preceded by M.E. 562.
Conference course permitting considerable latitude in choice of topics. Professor Quinn.

667. ADVANCED DYNAMICAL PROBLEMS IN MACHINE DESIGN. Sem. 2. cr. 3

Must be preceded by M.E. 470, M.E. 567, and Math. 421.

Design of devices dependent upon velocity or acceleration-time relationships; differential equations of motion to obtain design data and operating characteristics; analytical and graphical solutions.

Professor Quinn.

670. ADVANCED MACHINE DESIGN PROJECTS. cr. 2 to 6

Must be preceded by M.E. 570.

Design of an original machine to perform some specified function.

Professor Ault.

671. BEARINGS AND LUBRICATION. Sem. 1. cr. 3

Offered in September of odd numbered years.

Must be preceded by M.E. 371 or 470.

Anti-friction bearings, internal stress conditions, endurance, load ratings, selection and application; hydrodynamic theory of lubrication as applied to journal and thrust bearings.

Professor Ault.

672. GEARS. Sem. 1. cr. 3

Offered in September of even numbered years.

Must be preceded by M.E. 371 or 470.

Tooth forms; geometric and kinematic relationships of tooth action; capacity, ratings for strength and durability; forming and finishing methods and their effects on design and rating of gears.

Professor Ault.

673. RESILIENT MACHINE MEMBERS. Sem. 2. cr. 3

Offered in February of even numbered years.

Must be preceded by M.E. 371 or 470.

For resilient machine members: materials and their treatment, stress analysis, vibration, creep and relaxation, stability.

Professor Lusk.

680. RESEARCH TECHNIQUES IN MECHANICAL ENGINEERING. Sem. 1 and 2. Class 2, Lab. 3, cr. 3

Primarily for graduate students assigned to laboratory theses.

Instrumentation and techniques for measurement of pressure, temperature, time, strain, etc., as generally encountered in mechanical engineering research.

Professor Brock.

690. INTERNAL COMBUSTION ENGINE SEMINAR. Sem. 2. cr. 2 to 6

Must be preceded by M.E. 640.

Conferences on selected subjects, with review of literature and presentation of oral and written reports.

Professor Cromer.

691. GAS TURBINES AND JET PROPULSION SEMINAR. Sem. 1. cr. 2 to 10

Must be preceded by M.E. 651.

Analysis of current topics.

Professor Zucrow.

692. THERMODYNAMICS SEMINAR. Sem. 1 and 2. cr. 1 to 6

Must be preceded by M.E. 600 or 616.

Library research and discussions on selected topics in thermodynamic processes, heat and mass transfer applications of thermodynamics, and related topics; physiological applications of the laws.

Professor Touloukian.

697. MECHANICAL ENGINEERING PROJECTS. SS. Sem. 1 and 2.

Credit and hours to be arranged.

Staff.

698. RESEARCH IN MECHANICAL ENGINEERING. SS. Sem. 1 and 2

For Master of Science Degree.

Staff.

699. RESEARCH IN MECHANICAL ENGINEERING. SS. Sem. 1 and 2

For Doctor of Philosophy Degree.

Staff.

REQUIRED COURSES

Required courses given in the program of study of the several schools and curricula of engineering but administered by divisions outside of the schools and departments are listed below. Complete descriptions of courses may be found in the catalogs of the School of Science, Education and Humanities. Offerings in the Army, Navy and Air Force ROTC are described in the *General Information Bulletin.*

BIOLOGICAL SCIENCES

Bacteriology

211. BACTERIOLOGY. SS. Sem. 1 and 2. Class 2, Lab. 4, cr. 4
(3 A, H, 7 P, op. 5 C, el. S)

Must be preceded by Chem. 112 and Biol. 101 or Pl. Sc. 142, or Pl. Sc. 140, except for juniors in civil engineering.

CHEMISTRY

101. GENERAL CHEMISTRY.
Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (1 Engr, I, op. 1 A, S)

102. GENERAL CHEMISTRY.
SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4 (2 Engr, I, op. 2 A, S)
Required of all engineering students who do not take Chem. 118.
Continuation of Chem. 101.

117. ADVANCED GENERAL CHEMISTRY.
Sem. 1. Class 3, Lab. 3, cr. 4 (Freshmen)

Prerequisites: Satisfactory record of one year of high-school chemistry and high standing on orientation tests.

118. ADVANCED GENERAL CHEMISTRY.
Sem. 2. Class 3, Lab. 3, cr. 4 (Freshmen)

226. QUALITATIVE ANALYSIS.
SS. Sem. 1 and 2. Class 2, Lab. 6, cr. 4 (3 Ch, Met, el. A, H, S)

227. INTRODUCTORY QUANTITATIVE ANALYSIS.
SS. Sem. 1 and 2. Class 2, Lab. 6, cr. 4 (4 or 5 Ch, Met)
Must be preceded by Chem. 226.

251. ORGANIC CHEMISTRY.
SS. Sem. 1 and 2. Class 4, cr. 4 (3 A, F, H, 4 H, S)
Must be preceded by Chem. 102, 108, 112, or 118.

252. ORGANIC CHEMISTRY.
Sem. 1 and 2. Class 1, cr. 1 (3 A, 3 F, H, el. S)
Laboratory demonstration to accompany Chem. 251L.

413. CHEMICAL LITERATURE FOR ENGINEERS.
Sem. 1 and 2. Class 1, cr. 1 (el. Ch Met)

551. ORGANIC CHEMISTRY.
Sem. 1. Class 3, Lab. 5, cr. 4 (5 Ch, el. A, H, S)
Must be preceded by Chem. 102, 108, 110, 112, 118 and 223 or 226.

552. ORGANIC CHEMISTRY.
Sem. 2. Class 3, Lab. 5, cr. 4 (6 Ch, el. A, H, S)

573. PHYSICAL CHEMISTRY.
SS. Sem. 1. Class 3, Lab. 3, cr. 4 (5 Ch, Met, el. A, H, S)
Must be preceded by Chem. 227 or 421 and Math. 242; must be preceded or accompanied by Phys. 230 or equivalent.

574. PHYSICAL CHEMISTRY.
SS. Sem. 2. Class 3, Lab. 3, cr. 4 (6 Ch, Met, el. A, H, S)
Continuation of Chem. 573.

ECONOMICS

210. PRINCIPLES OF ECONOMICS.
Sem. 1 and 2. Class 3, cr. 3 (S, Eng, A, el. Ph.)
Credit will not be given for both Econ. 210 and 211.

370. ELEMENTS OF ACCOUNTING I.
Sem. 1 and 2. Class 3, cr. 3 (op. or el.)

371. ELEMENTS OF ACCOUNTING II.
Sem. 1 and 2. Class 3, cr. 3 (op. or el.)

382. ECONOMIC GEOGRAPHY. Sem. 1 and 2. Class 3, cr. 3 (6 AT, el.)

570. COST ACCOUNTING. Sem. 1 and 2. Class 3, cr. 3 (op. 7 M, el.)

571. ADVANCED COST ACCOUNTING. Sem. 1 and 2. Class 3, cr. 3 (el.)

422. AIR TRANSPORTATION ECONOMICS.
Sem. 2. Class 3, cr. 3 (8 AT, el.)
Must be preceded by Econ. 520.

473. AVIATION LAW. Sem. 1 and 2. Class 2, cr. 2 (6 AT)
Must be preceded by Econ. 470.

520. GOVERNMENT AND BUSINESS.
Sem. 1 and 2. Class 3, cr. 3 (el. 5, 6, 7, 8)
Must be preceded by Econ. 210 or 211.

470. BUSINESS LAW. Sem. 1 and 2. Class 3, cr. 3 (el.)

ENGLISH

1. ENGLISH COMPOSITION. SS. Sem. 1 and 2. Class 3, cr. 0 (Freshmen)
For students who fail to pass the orientation examination.

2. ENGLISH FOR FOREIGN STUDENTS. SS. Sem. 1 and 2. cr. 0
All foreign students, graduates or undergraduates, unless excused by the Adviser for Foreign Students, will be assigned to the course upon entrance to the University.

3. ENGLISH COMPOSITION. SS. Sem. 1 and 2. cr. 0
Students whose written work in English is found deficient by the Committee on Standards in English may be assigned to this course.

101. ENGLISH COMPOSITION.
SS. Sem. 1 and 2. Class 3, cr. 3 (Freshmen)
Prerequisite to all other courses in English except Engl. 1, 2, 3, 103 and 185.

103. ENGLISH COMPOSITION.
SS. Sem. 1 and 2. Class 3, cr. 3 (Freshmen)

Students who receive grade C will be excused from Engl. 202 and given credit for Engl. 101; those who receive grade D must take Engl. 101 or 202, depending upon the recommendation of the Engl. 103 instructor; those who fail to pass Engl. 103 must take both Engl. 101 and 202.

185. DEVELOPMENTAL READING.
SS. Sem. 1 and 2. Lab. 2, cr. ⅔ (1 or 2 S, el.)

202. ENGLISH COMPOSITION.
SS. Sem. 1 and 2. Class 3, cr. 3 (3, 4, 5, 6, 7, or 8)

A student who has received a grade of A or B in Engl. 101 may, with the approval of the head of the Department of English, substitute for Engl. 202 an advanced course in English.

233. READINGS IN THE OLD AND NEW INFORMAL ESSAY.
Sem. 1 and 2. Class 3, cr. 3 (op. 2 or 3 Engr, I, PE, 2 H, 4 P)

235. INTRODUCTION TO THE DRAMA.
SS. Sem. 1 and 2. Class 3, cr. 3 (op. 2 or 3 Engr, I, PE, 2 H)

237. INTRODUCTION TO POETRY.
Sem. 1 and 2. Class 3, cr. 3 (op. 2 and 3, Engr, H)

238. INTRODUCTION TO FICTION.
SS. Sem. 1 and 2. Class 3, cr. 3 (1 Engr, op. 1 S)

250. GREAT AMERICAN BOOKS.
SS. Sem. 1 and 2. Class 3, cr. 3 (op. 2 H, 2 or 3 Engr)

HISTORY, GOVERNMENT AND PHILOSOPHY

History

205. THE UNITED STATES AND ITS PLACE IN WORLD AFFAIRS.
Sem. 1 and 2. Class 3, cr. 3

210. HISTORY OF EUROPE SINCE 1914.
Sem. 1 and 2. Class 3, cr. 3 (el. 3, 4, 5, 6, 7, 8)

Credit will not be given for both Hist. 210 and 415.

Government

101. INTRODUCTION TO GOVERNMENT.
Sem. 1 and 2. Class 3, cr. 3 (op. 1 S, el. 1, 2, 3)

301. ELEMENTS OF DEMOCRACY.
Sem. 1 and 2. Class 3, cr. 3 (el. 5, 6, 7, 8)

331. INTERNATIONAL RELATIONS.
Sem. 1 and 2. Class 3, cr. 3 (el. 5, 6, 7, 8)

510. POLITICAL PARTIES AND POLITICS.
Sem. 2. Class 3, cr. 3 (el. 5, 6, 7, 8)

MATHEMATICS*

1. HIGH SCHOOL ALGEBRA. Sem. 1. Class 5, cr. 0
Credit, one unit for admission.

2. PLANE GEOMETRY. Sem. 1 and 2. Class 5, cr. 0
Credit, one unit for admission.

3. SOLID GEOMETRY. Sem. 1 and 2. Class 2, cr. 0 (I, Engr)
Credit, one-half unit for admission.

4. ADVANCED HIGH SCHOOL ALGEBRA. Class 2, cr. 0
Credit one-half unit for admission.

Math. 1, 2, 3 and 4 are for engineering students with entrance deficiencies in these subjects.

131. ELEMENTARY ENGINEERING MATHEMATICS.
Sem. 1 and 2. Class 6, cr. 5 (op. 1 Engr)
For students with inadequate preparation for Math. 141.

132. ELEMENTARY ENGINEERING MATHEMATICS.
Sem. 1 and 2. Class 6, cr. 5 (op. 2 Engr)

141. ALGEBRA AND TRIGONOMETRY.
SS. Sem. 1 and 2. Class 5, cr. 5 (op. 2 or 3 Engr, I, PE, 2 H)
Required for engineering students and science students who major in mathematics, physics, or chemistry. Students with inadequate preparation will be assigned to Math. 131.

142. ANALYTIC GEOMETRY.
SS. Sem. 1 and 2. Class 5, cr. 5 (2 Engr, op. 2 S)
Must be preceded by Math. 141 or 111 and 112.

241. CALCULUS I. SS. Sem. 1 and 2. Class 4, cr. 4 (3 Engr, op. 3 S)
Must be preceded by Math. 142 or 132.

242. CALCULUS II. SS. Sem. 1 and 2. Class 4, cr. 4 (4 Engr, op. 4 S)
Must be preceded by Math. 241.

421. BUSINESS WRITING: ENGINEERING APPLICATIONS.
SS. Sem. 1 and 2. Class 3, cr. 3 (op. 5, 6, 7, 8 Engr)

421. DIFFERENTIAL EQUATIONS AND APPLICATIONS.
SS. Sem. 1 and 2. Class 3, cr. 3 (6 E)

PHYSICS

220. GENERAL PHYSICS. SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4
(3 I, S, AT, 5 P, op. 5 A)
Must be preceded by Math. 111 and 112 or by Math. 101.

221. GENERAL PHYSICS. SS. Sem. 1 and 2. Class 3, Lab. 3, cr. 4
(4 I, S, AT, 6 P, op. 6 A)
Must be preceded by Phys. 220.

230. GENERAL PHYSICS. SS. Sem. 1 and 2.
Class 4, Lect. Dem. 1, cr. 4⅓ (3 Ch, C, Met)
Must be preceded by Math. 141 and 142.

231. GENERAL PHYSICS. SS. Sem. 1 and 2.
Class 4, Lect. Dem. 1, cr. 4⅓ (4 Ch, C, Met)
Must be preceded by Phys. 230.

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* Engineering students take Math. 141, 142, 241 and 242 in their freshman and sophomore years. Those with inadequate preparation take Math. 131, 132, 241, and 242.

240. GENERAL PHYSICS.
SS. Sem. 1 and 2. Class 4, Lect. Dem. 1, Lab. 2, cr. 5
(3 Aero, AgE, E, Em, L, M, op. S)
Must be preceded or accompanied by Math. 141 and 142.

241. GENERAL PHYSICS.
SS. Sem. 1 and 2. Class 4, Lect. Dem. 1, Lab. 2, cr. 5
(4 Aero, AgE, E, Em, L, M, op. S)
Must be preceded by Phys. 240.

540. X-RAY TECHNOLOGY. Sem. 1 and 2. Class 2, Lab. 3, cr. 3
Must be preceded by Phys. 330 or E.E. 315 and 316.

PSYCHOLOGY

120. ELEMENTARY PSYCHOLOGY. SS. Sem. 1 and 2. Class 3, cr. 3

320. FIRST COURSE IN PSYCHOLOGY FOR ENGINEERS.
SS. Sem. 1 and 2. Class 3, cr. 3
(5 Met, 6 M, 7 Aero, AgE, E, 8 Ch, C, Em)
Not open to students who have had Psy. 120.

SPEECH

114. PRINCIPLES OF SPEECH. SS. Sem. 1 and 2. Class 3, cr. 3
(1 or 2, A, PE, 1, 2, 3, 4, 5, 6, Engr, I, el.)

STAFF

SCHOOLS OF ENGINEERING

GEORGE ANDREW HAWKINS (1930)..................Dean of the Schools of Engineering; Director of the Engineering Experiment Station; Professor of Thermodynamics
B.S.M.E., Purdue, 1930; M.S.M.E., 1932; Ph.D., 1935 (P.E., Indiana).

JOHN THOMAS AGNEW (1940-1946; 1951)..........................Professor of Mechanical Engineering
B.S.Ch.E., Purdue, 1940; M.S.Met.E., 1942; Ph.D., 1944.

CAROL WESLEY ALLEN (1953)..............Instructor in Mechanical Engineering; Assistant in the Engineering Experiment Station
B.S.M.E., Purdue, 1953; M.S.M.E., 1954 (E.I.T., Indiana).

ADOLPH GEORGE ALTSCHAFFL (1952)..................Instructor in Civil Engineering
B.S.C.E., Purdue, 1952 (E.I.T., Indiana)

HAROLD THOMAS AMRINE (1946)..................Professor of Industrial Engineering
B.S.M.E., Iowa, 1938; M.S.M.E., 1939 (P.E., Indiana).

REIDAR LARS ANDERSON (1943)...............Assistant Professor of Engineering Sciences
B.S.E.E., Purdue, 1939; M.S.E., 1948 (P.E., Indiana).

JOSEPH NORMAN ARNOLD (1930)..........................Associate Professor of General Engineering
E.E., Cincinnati, 1927; M.S.E.E., Purdue, 1933 (P.E., Indiana).

EUGENE STANLEY AULT (1937)..............................Professor of Machine Design
B.S.M.E., Johns Hopkins, 1920; M.E., Cornell, 1921; M.M.E., 1924 (P.E., Ohio).

EDWARD WILLIAM AZPELL (1937)........................Associate Professor of Mechanical Engineering
B.S., Wisconsin, 1929; M.S.E., 1930 (P.E., Indiana).

JOHN EDWARD BAERWALD (1949)............Research Engineer, Joint Highway Research Project, Engineering Experiment Station
B.S.C.E., Purdue, 1949; M.S.C.E., 1950 (P.E., Indiana).

RALPH EVERETT BALYEAT (1949)..........................Associate Professor of Industrial Engineering
B.S.E.E., Ohio State, 1928; M.A., Toledo, 1943 (P.E., Indiana)

JAMES HOWARD BASINGER (1946)..........................Instructor in Air Transportation
B.S., Parks Air College, 1941; B.S., St. Louis, 1947.

LESTER ELMER BECK (1928)..........................Professor of Electrical Engineering
B.S.E.E., Pennsylvania State, 1926; M.S.E.E., Purdue, 1932 (P.E., Indiana).

WILLIAM LEHMAN BELL (1954)..............................Instructor in Engineering Drawing
B.S.C.E., Illinois Institute of Technology, 1943.

CARROLL OSBORNE BENNETT (1949)..................Associate Professor of Chemical Engineering
B.S., Worcester Polytechnic, 1943; D.Eng., Yale, 1950.

VOLLMAR EDGAR BERGDOLT (1945-1946; 1953)..........................Assistant in the Engineering Experiment Station
B.S.M.E., Purdue, 1939; M.S.M.E., 1946.

GUSTAV WALTER BERGREN (1940-1941; 1945)......................Associate Professor of Mechanical Engineering
B.S., Colorado A. and M., 1940; M.S.M.E., Purdue, 1948 (P.E., Indiana).

RAYMOND CHARLES BINDER (1936)..............................Professor of Mechanical Engineering
S.B., Massachusetts Institute of Technology, 1930; M.S., California Institute of Technology, 1933; Ph.D., 1936 (P.E., Indiana).

DAVID LEE BJORNDAHL (1951)..........................Instructor in Electrical Engineering
B.S.E.E., Purdue, 1951; M.S.E.E., 1953 (E.I.T., Indiana).

JACK BAILEY BLACKBURN (1948)..........................Research Engineer, Joint Highway Research Project, with the rank of Instructor, Engineering Experiment Station
B.S.C.E., Oklahoma, 1947; M.S.C.E., Purdue, 1949 (P.E., Indiana).

GROVER CLEVELAND BLALOCK (1915)..............................Professor of Electrical Engineering; Assistant Director of the Electrical Engineering Laboratory
B.S.E.E., Michigan, 1910; E.E., Purdue, 1917 (P.E., Indiana).

DON EVANS BLOODGOOD (1943)........................Professor of Sanitary Engineering; Associate in the Engineering Experiment Station; Sanitary Engineer, Division of Technical Extension
B.S., Wisconsin, 1926; C.E., 1935 (P.E., Indiana).

LLEWELLYN MICHAEL KRAUS BOELTER (1952)........Visiting Professor of Engineering
B.S., California (Berkeley), 1917; M.S., 1918.

FREDERICK JAMES BOGARDUS (1947)....................Assistant Professor of Mechanical Engineering
B.S.M.E., Rose Polytechnic, 1932; M.S.M.E., Yale, 1934; Ph.D., Purdue, 1954 (P.E., Pennsylvania).

JOHN LEE BOGDANOFF (1950)...........................Professor of Engineering Sciences
B.M.E., Syracuse, 1938; S.M., Harvard, 1939; Ph.D., Columbia, 1950.

MYRL HERBERT BOLDS (1932-1938; 1942)........................Instructor in Engineering Drawing
B.S.I.Ed., Purdue, 1937; M.S.Ed., 1954.

JOSEPH BORODAVCHUK (1945)......................Instructor in Manufacturing Processes

JACOBUS MARINUS BOTJE (1951)........Assistant in the Engineering Experiment Station
Werktuigbouwkundig Ingenieur (M.E.),
Middlebare Technische School
(Netherlands), 1947; Werktuigbouwkundig Ingenieur (M.E.), Technische Hogeschool te Delft
(Netherlands), 1950; M.S.M.E., Purdue, 1951.

KENNETH EUGENE BOTKIN (1948)............Assistant Professor of Engineering Drawing
B.S.M.E., Purdue, 1948; M.S.I.E., 1954.

JAMES ALLISON BOTTORFF (1952)........Assistant in the Engineering Experiment Station
B.S., Missouri School of Mines, 1952; M.S.Ch.E., Purdue, 1954.

JAMES HAROLD BOWMAN (1928).....................Professor of Electrical Engineering; Member of Purdue-Taiwan College of Engineering Team in Formosa, 1953-1954, 1954-1955.
B.S.E.E., Purdue, 1924; E.E., 1933; M.S.E., 1934 (P.E., Indiana).

ARTHUR KENNETH BRANHAM (1939)........................Associate, Joint Highway Research Project, Engineering Experiment Station; Instructor in Highway Engineering
B.S., Bradley Polytechnic, 1934; M.A., Iowa, 1938.

HAROLD HUSTON BRELSFORD (1918)..................Instructor in Engineering Drawing

WILLIAM WALTER BRIGGS (1946)...........................Assistant Professor of Air Transportation
A.B., Michigan, 1932; M.S., Purdue, 1949.

JAMES EPHRIAM BROCK (1944).............Associate Professor of Mechanical Engineering
B.S., Marion Normal, 1912; A.B., Indiana, 1919; M.A., 1923; Ph.D., 1928.

CHARLES LEONARD BROWN (1940)......................Associate Professor of Mechanical Engineering
B.S., Rice, 1940; M.S.M.E., Purdue, 1943; Ph.D., 1949.

ELMER FRANK BRUHN (1941)...............................Professor of Aeronautical Engineering (Head of the School of Aeronautics, 1947-1950
B.S.C.E., Illinois, 1923; M.S., Colorado School of Mines, 1925; C.E., Illinois, 1928 (P.E., Indiana).

JAMES ROBERT BURNETT (1946)........................Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1946; M.S.E.E., 1947; Ph.D., 1949.

JOHN MARTIN CAGE (1947)............................Professor of Electrical Engineering
B.S.E.E., Iowa State, 1931; E.E., 1939 (P.E., Indiana).

WILBUR EUGENE CAMP (1942).....................Assistant Professor of Civil Engineering
B.S.C.E., Purdue, 1929; M.S.Ed., 1952 (P.E., Indiana).

DONALD TREAT CANFIELD (1921)......................Professor of Electrical Engineering
B.S., Worcester Polytechnic, 1920; M.S.E.E., Purdue, 1924; E.E., Worcester Polytechnic, 1935 (P.E., Indiana).

LAWRENCE TONY CARGNINO (1945) . . . . . . Assistant Professor of Air Transportation
B.Ed., Illinois State Normal, 1941; M.S.Ed., Purdue, 1948.

RICHARD CLAIRE CARPENTER (1953) . . . . . . Instructor in Engineering Drawing
B.S., United States Military Academy, 1929.

ARTHUR HUGH CARTER (1929) . . . . . . Associate Professor of Engineering Drawing
B.S.A., Ohio State, 1917; B.S.Arch., 1925 (P.E., Indiana).

PAUL WESLEY CASE (1932) . . . . . . Associate Professor of Manufacturing Processes
B.S.T.&I.E., Purdue, 1940; M.S.Ed., 1945.

WILLIAM JOHN CHALMERS (1950) . . . . . . Instructor in Electrical Engineering
B.S.E.E., Purdue, 1950; M.S.E.E., 1952.

SHERMAN DANIEL CHAMBERS (1921) . . . . . . Professor Emeritus of Engineering Mechanics
B.S., Baldwin-Wallace, 1904; M.S., 1911; C.E., Lehigh, 1918.

CHARLES ROBERT CHAPMAN (1948) . . . . . . Instructor in Electrical Engineering
B.S.E.E., Northwestern, 1941; M.S.E.E., Purdue, 1951.

PAUL FRANKLIN CHENEA (1952) . . . . . . Assistant Dean of the Schools of Engineering; Head of the Division of Engineering Sciences; Professor of Engineering Sciences
B.S., California, 1940; M.S., Michigan, 1946; Ph.D., 1949 (P.E., Michigan and Indiana).

RICHARD KUO-WEI CHENG (1950-1951; 1953) . . . . . . Instructor in Electrical Engineering
B.S.E.E., Purdue, 1950; M.S.E.E., 1951.

DAVID SEEGER CLARK (1931) . . . . . . Professor of Mechanical Engineering
B.S.M.E., Purdue, 1925; M.S.E., 1936 (P.E., Indiana).

JOHN RAY CLARK (1939-1940; 1941-1944; 1946) . . . . . . Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1939; M.S.E., 1941; Ph.D., Ohio State, 1952.

†MILTON URE CLAUSER (1950) . . . . . . Head of the School of Aeronautics; Professor of Aeronautical Engineering
B.S., California Institute of Technology, 1934; M.S., 1935; Ph.D., 1937.

ALLEN GRINNELL CLEAVER (1948) . . . . . . Instructor in Engineering Drawing, Division of Technical Extension
B.S., Indiana State Teachers, 1926.

ROBERT EUGENE COCHRAN (1952) . . . . . . Instructor in Manufacturing Processes
B.S.T. & I.E., Purdue, 1950.

JAMES VERNON CODDINGTON (1954) . . . . . . Instructor in Engineering Drawing
B.S.I.Ed., Purdue, 1954.

RAYMOND COHEN (1947) . . . . . . Instructor in Mechanical Engineering
B.S.M.E., Purdue, 1947; M.S.M.E, 1950 (E.I.T., Indiana).

JAMES DOUGLAS COLLINS (1954) . . . . . . Instructor in Engineering Drawing
B.S.M.E., Michigan State, 1938.

EDWARD WALTER COMINGS (1951) . . . . . . Head of the School of Chemical and Metallurgical Engineering; Professor of Chemical Engineering
B.S., Illinois, 1930; Sc.D., Massachusetts Institute of Technology, 1934 (P.E., Illinois).

ROBERT ANTON COMPARIN (1953) . . . . . . Instructor in Mechanical Engineering
B.S.M.E., Purdue, 1954.

ROBERT RUNYON COON (1951) . . . . . . Instructor in Electrical Engineering
B.S.E.E., Purdue, 1951; M.S.E., 1953.

GEARLD KEITH COOPER (1946-1951; 1952) . . . . . . Instructor in Engineering Sciences
B.S.Aero.E., Purdue, 1946; M.S.E.M., 1949 (E.I.T., Indiana).

GEORGE ROBERT COOPER (1943) . . . . . . Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1943; M.S.E.E., 1945; Ph.D., 1949.

HANS COSTER (1953) . . . . . . Instructor in Manufacturing Processes
Ingenieur, Delft (Netherlands), 1951; M.S. Ind. Engr., Purdue, 1953.

JAMES COUGHLIN (1948) . . . . . . Assistant Professor of Mechanical Engineering
B.S., Detroit, 1948; M.S.M.E., Purdue, 1950; Ph.D., 1953.

WILLIAM CURTIS CRAWFORD (1953) . . . . . . Instructor in Electrical Engineering
B.S.E.E., Purdue, 1953 (E.I.T., Indiana).

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† On leave of absence, 1954-1955.

•PAUL DAY CRIBBENS (1952)............................Instructor in Engineering Drawing
B.S., United States Merchant Marine Academy, 1948; B.S.C.E., Alabama, 1952.

ROBERT LA FOLLETTE CRIST (1953)..................Instructor in Engineering Drawing
B.S.C.E., Illinois, 1949.

ORVILLE CHARLES CROMER (1942)....................Associate Professor of Mechanical Engineering
B.S.M.E., Wisconsin, 1930; M.S.M.E., 1931; M.E., 1938 (P.E., Indiana).

KENNETH STEWART CURTIS (1946)..............Assistant Professor of Civil Engineering
B.S.C.E., Purdue, 1946; M.S.C.E., 1949 (P.L.S., Indiana).

DAVID LINDER CURTNER (1911)........................Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1911; E.E., 1913.

CHESTER SHERMAN CUTSHALL (1920)........................Professor of Engineering Sciences
B.S.Ch.E., Purdue, 1919; M.S.Ch.E., 1924 (P.E., Indiana).

ALVIN CECIL DALE (1949).................Associate Professor of Agricultural Engineering
B.S., Tennessee, 1941; M.S., Iowa State, 1942; Ph.D., 1950 (P.E., Indiana).

HAROLD MILLER DeGROFF, JR. (1951)..........Acting Head of the School of Aeronautics; Professor of Aeronautical Engineering
B.A.E., Rensselear Polytechnic, 1946; M.S., California Institute of Technology, 1947; A.E., 1948; Ph.D., 1949.

J. PHILIP MORRIS DIAMOND (1953)......Assistant in the Engineering Experiment Station
B.M.E., New York, 1951; M.S.M.E., Buffalo, 1954 (E.I.T., New York).

WILLIAM LEE DOLCH (1947)..........................Assistant, Joint Highway Research Project, Engineering Experiment Station
B.S.Ch.E., Purdue, 1947; M.S., 1949.

THOMAS CLARE DOODY (1947)..........................Associate Professor of Chemical Engineering; Member of Purdue-Taiwan College of Engineering in Formosa, 1953-1954, 1954-1955
B.S., California, 1924; M.S., 1925; Ph.D., 1938 (P.E., Indiana).

ROBERT ALDEN DOUGLAS (1951)....................Instructor in Engineering Sciences
B.S.E.M., Purdue, 1951; M.S.E.M., 1952 (E.I.T., Indiana).

ALLAN CARLTON DUNK (1950)..................Instructor in Mechanical Engineering
B.A.Sc.M.E., Toronto (Canada), 1950; M.S.M.E., Purdue, 1951.

JOHN WILLIAM DUNKIN (1954)...........Assistant, Joint Highway Research Project, Engineering Experiment Station
B.S.E.M., Purdue, 1953; M.S.E.M., 1954 (E.I.T., Indiana).

BEHREND JOSEPH DuWALDT (1954)..................Instructor in Electrical Engineering
B.S., United States Naval Academy, 1949; M.S.E., Purdue, 1954.

JAMES ROBERT EATON (1940-1941; 1942)........................Professor of Electrical Engineering; Supervisor of Network Analyzer Laboratory
B.S.E.E., Purdue, 1925; E.E., 1930; M.S.E.E., Wisconsin, 1938; Ph.D., Purdue, 1942 (P.E., Indiana).

PAUL BERNARD EATON (1948)..............Assistant Professor of Manufacturing Processes
B.S.M.E., Notre Dame, 1948; M.S. Ind. Eng., Purdue, 1951.

PAUL BURNS EATON (1953).......Professor of Mechanical Engineering; Member of Purdue-Taiwan College of Engineering Team in Formosa, 1953-1954, 1954-1955
M.E., Cornell, 1911 (P.E., Pennsylvania).

CARL ALEXANDER EGNER (1947)......................Associate Professor of Surveying
B.S.C.E., Purdue, 1914; C.E., 1920 (P.E., Indiana).

AHMED HANAFY EL-ABIAD (1952)......................Instructor in Electrical Engineering
B.Sc., Fouad I (Egypt), 1948; M.S.E.E., Purdue, 1953.

DAVID GEORGE ELLIOTT (1953)...........Assistant in the Engineering Experiment Station
B.S., California Institute of Technology, 1951; M.S., 1952.

STEPHEN BRUCE ELROD (1930)..............................Professor of Engineering Drawing
B.S.M.E., Purdue, 1935; M.S.E., 1939 (P.E., Indiana).

ALDEN HAYES EMERY, JR. (1954).............Assistant Professor of Chemical Engineering
B.S., Pennsylvania State, 1947; S.M., Massachusetts Institute of Technology, 1949.

• Leave of absence for military duty, first semester 1954-1955.

AHMED CEMAL ERINGEN (1953)................Associate Professor of Engineering Sciences; Assistant in the Engineering Experiment Station
M.S., Advanced Engineering School of Istanbul (Turkey), 1943; Ph.D., Polytechnic Institute of Brooklyn, 1948.

DILLON EVERS (1948)................Associate Professor of Metallurgical Engineering
B.S.Ch.E., Iowa, 1931; M.S.Ch.E., 1932; Ph.D., 1936 (P.E., Indiana).

DRESSEL DEWITT EWING (1912)..............Professor Emeritus of Electrical Engineering
E.E., M.E., Ohio Northern, 1906; D.Eng., 1936 (P.E., Indiana).

SEIBERT FAIRMAN (1921)................Professor of Engineering Sciences
B.S.M.E., Kansas State, 1919; M.S.M.E., Purdue, 1923; M.E., Kansas State, 1924 (P.E., Indiana).

PAULA BERGER FEUER (1942-1949; 1950-1951; 1952)....Instructor in Engineering Sciences
A.B., Hunter, 1941; M.S., Purdue, 1945; Ph.D., 1951.

DONALD BALCH FITZPATRICK (1947)................Assistant Professor of Electrical Engineering
B.E.E., Rensselaer Polytechnic, 1947; M.S.E.E., Purdue, 1950.

WILLIAM ELLSWORTH FONTAINE (1937)................Associate Professor of Mechanical Engineering
A.B., Central Y.M.C.A., 1936; B.S.M.E., Purdue, 1942; M.S.M.E., 1943 (P.E., Indiana).

MART IRVING FOWLER (1947)................Associate Professor of Air Transportation
B.Ed., Indiana State Teachers, 1921; B.S., Pittsburgh, 1935; M.Ed., 1938.

WILFRED ISAAC FREEL (1925)........Associate Professor of Civil Engineering; Member of Purdue-Taiwan College of Engineering Team in Formosa, 1954-1955
B.S.C.E., Purdue, 1925; M.S.C.E., 1929 (P.E., Indiana).

STEPHEN FREEMAN, JR. (1948)................Associate Professor of Electrical Engineering
S.B.E.E., Massachusetts Institute of Technology, 1925; M.S.E.E., 1926 (P.E., Indiana).

ROBERT EDSON FROST (1904)................Associate Professor of Highway Engineering; Research Engineer, Joint Highway Research Project, Engineering Experiment Station
B.S.C.E., Purdue, 1940; M.S.C.E., 1942; C.E., 1947 (P.E., Indiana).

MARY GRACE GAGEN (1950)................Administrative Assistant, Engineering

EDWARD CHARLES GALLETT (1954)......Instructor in Engineering Drawing, Division of Technical Extension
B.S.M.E., Illinois Institute of Technology, 1947.

JOHN WILLIAM GEIGER (1920)................Assistant Professor of Mechanical Engineering
B.S.M.E., Purdue, 1920; M.S.M.E., 1923.

ROBERT CARL GELDMACHER (1947)..........Associate Professor of Engineering Sciences; Research Engineer, Joint Highway Research Project, Engineering Experiment Station
B.E., Northern Illinois State Teachers (De Kalb), 1942; M.S., Purdue, 1946 (P.E., Indiana).

ROSCOE HENRY GEORGE (1920)..............Research Professor of Electrical Engineering
B.S.E.E., Purdue, 1922; M.S.E.E., 1927 (P.E., Indiana).

*HENRY FRED GERDOM (1951)................Instructor in Engineering Drawing
B.S.T.&I.E., Purdue, 1951; M.S. Ind. Ed., 1953.

HARVEY FRANK GIRVIN (1927)................Professor of Engineering Sciences
B.M.E., Michigan, 1910.

WILLIAM HARNER GOETZ (1938)................Research Engineer, Joint Highway Research Project, Engineering Experiment Station; Associate Professor of Highway Engineering
B.S.Ch.E., Michigan, 1936; M.S.Ch.E., Purdue, 1942 (P.E., Indiana).

JOHN EDWARD GOLDBERG (1950)................Associate Professor of Structural Engineering
B.S.Eng., Northwestern, 1930; C.E., 1931; Ph.D., Illinois Institute of Technology, 1950 (P.E., Indiana).

BRAGE GOLDING (1946)..............Associate in the Engineering Experiment Station
B.S.Ch.E., Purdue, 1941; Ph.D., 1948 (E.I.T., Indiana).

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* Military leave of absence, 1954-1955.

BEN ROGER GOSSICK (1950).......Assistant Professor of Engineering Sciences
B.A., Pomona, 1939; M.A., Columbia, 1941; M.S., Ph.D., Purdue, 1954.

ROBERT JOHN GOULARD (1954).......Instructor in Mechanical Engineering
Diploma, Ecole Nationali Superieuri de l'Aeronautique (France), 1949.

RICHARD EDWARD GRACE (1954)....Assistant Professor of Metallurgical Engineering
B.S.Met.E., Purdue, 1951; Ph.D., Carnegie Institute of Technology, 1954.

ALFRED RAPP GRAHAM (1951).......Assistant in the Engineering Experiment Station
B.M.E., Syracuse, 1951; M.S.M.E., Purdue, 1953.

ROBERT MERLE GRAY (1948).......Assistant in the Engineering Experiment Station; Instructor in Engineering Sciences
B.S., Aero.E., Purdue, 1945; M.S.E., 1951 (E.I.T., Indiana).

FOREST HUBERT GREEN (1945).......Research Engineer Joint Highway Research Project, Engineering Experiment Station; Associate Professor of Highway Engineering
B.S.C.E., Purdue, 1926; M.S.C.E., 1947 (P.E., Indiana and Nebraska).

ARTHUR BERNARD GREENBERG (1950).......Assistant in the Engineering Experiment Station; Instructor in Mechanical Engineering
B.S.Aero.E.; B.S.M.E., Purdue, 1950; M.S.Aero.E., 1952 (E.I.T., Indiana).

JAMES HARNSBERGER GREENE (1948).......Assistant Professor of Industrial Engineering
B.S.M.E., M.S.Ind.E., Iowa, 1948.

RICHARD JOSEPH GROSH (1950; 1951).......Assistant Professor of Mechanical Engineering
B.S.M.E., Purdue, 1950; M.S.M.E., 1952; Ph.D., 1953 (E.I.T., Indiana).

MARTIN JOSEPH GUTZWILLER (1946).......Associate Professor of Structural Engineering
B.S.C.E., Purdue, 1944; M.S.C.E., 1949 (P.E., Indiana).

ALBERT GLASGOW GUY (1952).......Associate Professor of Metallurgical Engineering
S.B., Chicago, 1938; M.S., Ohio State, 1941; D.Sc., Carnegie Institute of Technology, 1946 (P.E., North Carolina).

HARRY WILLIAM HALE (1947).......Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1942; M.S.E.E., 1949; Ph.D., 1953 (P.E., Indiana).

ALLEN STRICKLAND HALL, JR. (1939).......Professor of Mechanical Engineering
B.S.M.E., Vermont, 1938; M.S.M.E., Columbia, 1939; Ph.D., Purdue, 1946 (P.E., Indiana).

JOHN OGDEN HANCOCK (1936).......Associate Professor of Engineering Sciences
S.B., Haverford, 1934; A.M., 1936; Ph.D., Purdue, 1940 (E.I.T., Indiana).

HERBERT RUSSELL HANLEY (1953).......Professor of Metallurgical Engineering; Member of Purdue-Taiwan College of Engineering Team in Formosa, 1953-54, 1954-55
B.S., Missouri School of Mines, 1901 (P.E., Missouri).

HUGH JUSTIN HANSEN (1952).......Assistant Professor of Agricultural Engineering
B.S., North Dakota Agricultural, 1951; M.S., Cornell, 1952.

GEORGE EDWARD HAPPELL (1928).......Associate Professor of Electrical Engineering
B.S., Allegheney, 1924; M.A., Nebraska, 1927; M.S.E., Purdue, 1934.

BRUCE LANCASTER HARDING (1954).......Instructor in Manufacturing Processes
B.S.M.E., Michigan State, 1954.

GEORGE FREDERICK HARTJE (1948).......Instructor in Manufacturing Processes
B.S., Eastern Kentucky State Teachers, 1942; M.S.Ed., Purdue, 1954.

JOHN ALAN HAVERS (1953).......Research Engineer, Joint Highway Research Project, Engineering Experiment Station
B.S.C.E., Saskatchewan (Canada), 1947; M.S.C.E., Purdue, 1952 (P.E., Indiana).

DONALD ROBERT HAWORTH (1954).......Instructor in Mechanical Engineering
B.S.M.E., Purdue, 1952 (E.I.T., Indiana).

JOHN MARION HAYES (1948).......Associate Professor of Structural Engineering
B.S.C.E., Purdue, 1931; M.S., Tennessee, 1944; C.E., Purdue, 1946 (P.E., Indiana and Tennessee).

WILLIAM HART HAYT, JR. (1946) .... Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1942; M.S.E.E., 1948; Ph.D., Illinois, 1954.

HOWARD JOHN HEIM (1925) .... Associate in the Engineering Experiment Station; Associate Professor of Electrical Engineering
B.S.E.E., Nebraska, 1922; E.E., 1938 (P.E., Indiana).

ENGELBERT WILLIAM HERMAN (1954) .... Instructor in Manufacturing Processes
B.S., Ball State Teachers, 1953.

THOMAS JEFFERSON HERRICK (1936-1942; 1945) .... Associate Professor
B.S.M.E., Illinois, 1936; M.S., Michigan, 1940 (P.E., Indiana).

WILFRED MARION HESSELBERTH (1938) .... Associate Professor of Electrical Engineering
B.S., Illinois, 1931; M.S., 1932.

HARRY HIROSHI HIGA (1954) .... Research Associate, Engineering Experiment Station
A.B. Univ. of Hawaii, 1940; M.S. Southern California, 1949; Ph.D., Syracuse, 1954.

SAMUEL CHARLES HITE (1943) .... Assistant Professor of Chemical Engineering
B.S.Ch.E., Purdue, 1943; Ph.D., 1951.

HAL LOVE HOLLISTER (1954) .... Instructor in Engineering Sciences
B.S., Oregon State, 1950.

ALFRED RICHARD HOLOWENKO (1946) .... Associate Professor of Mechanical Engineering
A.B., Harvard, 1938; M.S., 1939 (P.E., Texas).

JOHN PETER HOUSTRUP (1951) .... Assistant in the Engineering Experiment Station; Instructor in Engineering Sciences
B.S.Eng.Mech., Purdue, 1951; (E.I.T., Indiana).

WARREN EVERY HOWLAND (1926) .... Professor of Sanitary Engineering
B.S.San.E., Massachusetts Institute of Technology, 1922; M.S.C.E., Purdue, 1929; Sc.D., Harvard, 1939 (P.E., Indiana).

LESLIE ALAN HROMAS (1951) .... Instructor in Aeronautical Engineering
B.S., John Brown, 1951; M.S., Purdue, 1953.

THOMAS JOSIAH HUGHEL (1945) .... Assistant Professor of Metallurgical Engineering
B.S.Met.E., Purdue, 1942; Ph.D., 1951 (P.E., Indiana).

EUGENE BEUTLER HUNT (1953) .... Instructor in Electrical Engineering
B.Sc., South Dakota State, 1948; M.S.E.E., Kansas State, 1950.

RICHARD EARL HUNTER (1954) .... Instructor in Engineering Drawing
B.S.Aero.E., Purdue, 1948.

DONOVAN HARRIS JACOBY (1953) .... Instructor in Manufacturing Processes
A.B., Indiana Central Normal, 1928.

THOMAS BRADLEY JEFFERSON (1952) .... Instructor in Mechanical Engineering
B.S.M.E., Kansas State, 1949; M.S.M.E., Nebraska, 1950.

DAVID LAURENCE JOHNSON (1949) .... Instructor in Electrical Engineering
B.S.E.E., Idaho, 1948.

JOSEPH STUART JOHNSON (1954) .... Head of the School of Electrical Engineering; Professor of Electrical Engineering
B.S.E., Missouri, 1932; M.S.E.E., 1934; Ph.D., Iowa State, 1937 (P.E., Indiana and Florida).

JAMES GEORGE JOHNSTONE (1948) .... Research Engineer, Joint Highway Research Project, Engineering Experiment Station
Geol.Eng., Colorado School of Mines, 1948; M.S.E., Purdue, 1952 (P.E., Indiana).

JAMES BEVERLY JONES (1945) .... Associate Professor of Mechanical Engineering
B.S., Virginia Polytechnic, 1944; M.S.M.E., Purdue, 1947; Ph.D., 1951 (P.E., Indiana).

WILLIAM JAMIESON KAY (1939-1941; 1942-1943; 1946) .... Assistant Professor of Civil Engineering
B.S.Tech., New Hampshire, 1938; M.S.E., Purdue, 1941 (P.E., Indiana).

HAROLD MELVIN KELLEY (1954) .... Instructor in Manufacturing Processes
B.S.M.E., Purdue, 1942.

ROBERT DONALD KELLY (1953) .... Instructor in Engineering Drawing
B.S., Iowa State, 1951.

LLOYD H KEMMER (1935) .... Assistant Professor of Civil Engineering
B.S.C.E., Purdue, 1935; M.S.E., 1938 (P.E., Indiana).

JACK ELLSWORTH KEMMERLY (1953) .... Instructor in Electrical Engineering
B.E.E., Catholic University of America, 1950; M.S., Denver, 1952.

RICHARD KESSLER (1954) .... Instructor in Engineering Drawing
B.S.M.E., Texas A. and M., 1938 (P.E., New York, Ohio, and Texas).

ELWOOD GEORGE KIRKPATRICK (1946) .... Assistant Professor of Manufacturing Processes
B.S., Western Reserve, 1946; M.S., Purdue, 1952.

ALBERT FREDERICK KLINGE (1952) .... Instructor in Agricultural Engineering
B.S.Agr.Eng., Purdue, 1952.

WILLARD ALFRED KNAPP (1908) .... Associate Dean of the Schools of Engineering; Professor of Engineering
B.S.C.E., Illinois, 1907; C.E., Purdue, 1911 (P.E., Indiana).

JULIUS OTTO KOPPLIN (1954) .... Instructor in Electrical Engineering
B.S.E.E., Wisconsin, 1949; M.S.E.E., Purdue, 1954.

LAWRENCE ARDENNE KRAMER (1946) .... Associate Professor of Electrical Engineering
B.S.E.E., Michigan, 1929; M.S.E.E., Purdue, 1947 (P.E., Indiana).

JOHN WALLACE LAMBERT (1949) .... Instructor in Engineering Sciences
B.S.E., Michigan, 1949; M.S.E., Purdue, 1952 (E.I.T., Indiana).

DAVID JOSEPH LaMOTHE (1941) .... Associate Professor of Electrical Engineering
B.S.E.E., Michigan College of Mining and Technology, 1934; M.S.E.E., Purdue, 1946 (P.E., Indiana).

HIRAM GORDON LAREW (1947) .... Instructor in Soil Mechanics
B.S.C.E., West Virginia, 1944; M.S.C.E., Purdue, 1951 (P.E., Indiana).

ORVILLE DUANE LASCOE (1942) .... Professor of Manufacturing Processes
B.S., Western Kentucky State Teachers, 1938; M.S.Ed., Purdue, 1945.

HERMAN GLEYN LAUGHLIN (1947) .... Assistant Professor of Mechanical Engineering
B.S.M.E., Purdue, 1928; M.S.M.E., 1949 (P.E., New York).

CARL WILLIAM LAWTON (1946) .... Assistant in the Engineering Experiment Station; Assistant Professor of Engineering Sciences
B.C.E., Clarkson, 1942; M.S.Eng.Mech., Purdue, 1948 (P.E., Indiana).

WILLIAM KERNS LeBOLD (1954) .... Research Assistant in Engineering Education
B.E.E., Minnesota, 1945; M.S., Northwestern, 1953 (P.E., Illinois).

KENNETH HARVEY LENZEN (1949) .... Instructor in the Structural Engineering
B.S., Northwestern, 1943; M.S., 1946 (P.E., Indiana).

GERALD ALLEN LEONARDS (1946) .... Assistant Professor of Soil Mechanics
B.Eng., McGill (Canada), 1943; M.S.C.E., Purdue, 1948; Ph.D., 1952 (P.E., Indiana and Quebec).

ALBERT DALE MILTON LEWIS (1950-1952; 1954) .... Associate Professor of Structural Engineering
B.S.C.E., Purdue, 1941; M.S.C.E., 1951 (P.E., Indiana and California).

BEVAN BLAU LEWIS (1946) .... Professor of Railroad Engineering; Assistant Director, Formosa-Purdue Engineering Project
B.S.C.E., Purdue, 1921 (P.E., Indiana).

DONALD WILLIAM LEWIS (1941-1942; 1946) .... Research Engineer, Joint Highway Research Project, Engineering Experiment Station; Associate Professor of Highway Engineering
B.S.C.E., Wyoming, 1941; M.S.C.E., Purdue, 1942 (P.E., Indiana).

ROY WAYNICK LINDLEY (1921) .... Professor of Manufacturing Processes
B.S.M.E., Purdue, 1920; M.S.M.E., 1929 (P.E., Indiana).

JOSEPH LISTON (1937) .... Professor of Aeronautical Engineering
B.S.M.E., Purdue, 1930; M.E., 1935 (P.E., Indiana).

NEIL LITTLE (1926) .... Associate Professor of Engineering Sciences
A.B., DePauw, 1923; A.M., Michigan, 1926.

HSU LO (1949) .... Professor of Aeronautical Engineering
B.S.Aero.E., Thing Hua (China), 1940; M.S.Aero.E., Michigan, 1944; Ph.D., 1946.

GEORGE EDWARD LOMMEL (1912) .... Professor of Topographical Engineering
B.S.C.E., Purdue, 1910; C.E., 1916 (P.E., Indiana).

RICHARD WILLIAM LOUNSBURY (1953) .... Assistant Professor of Geology
B.S., Chicago, 1940; Ph.D., Stanford, 1950.

CHARLES WILLIAM LOVELL, JR. (1948) .... Research Engineer, Joint Highway Research Project, Engineering Experiment Station; Instructor in Civil Engineering
B.C.E., Louisville, 1944; M.S.C.E., Purdue, 1951 (P.E., Kentucky).

JAMES BEELER LUSK (1948) Assistant Professor of Mechanical Engineering
B.S.M.E., Purdue, 1935; M.S., Lehigh, 1937 (P.E., Indiana).

WARREN JACOB LUZADDER (1930) Professor of Engineering Drawing
B.S.C.E., Purdue, 1929; M.S.C.E., 1933 (P.E., Indiana).

RICHARD WOODROW McDOWELL (1949-1951; 1952) Instructor in Manufacturing Processes
B.S.T & I.E., Purdue, 1949.

JOHN FRANCIS McLAUGHLIN (1950) Assistant, Joint Highway Research Project, Engineering Experiment Station; Instructor in Highway Engineering
B.C.E., Syracuse, 1950; M.S.C.E., Purdue, 1953.

LLOYD RICHARD MAGNUSSON (1952) Instructor in Engineering Drawing
B.S.C.E., Purdue, 1950 (E.I.T., Indiana).

CLARENCE THOMAS MAREK (1937) Professor of Manufacturing Processes
B.S., St. Thomas, 1933; B.S.M.E., Purdue, 1942; M.S.M.E., 1944 (P.E., Indiana).

ARTHUR RICHARD MARKS (1954) Assistant Professor of Industrial Engineering
B.S., Manchester (England), 1948; M.S., California Institute of Technology, 1949.

*ROLAND BARTEL MARSHALL (1935) Associate Professor of Electrical Engineering
B.S.E.E., Purdue, 1923; M.S.E., 1941 (P.E., Indiana).

RAYMOND KEITH MASNAGHETTI (1951) Instructor in Electrical Engineering
B.S.E.E., Michigan College of Mining and Technology, 1949; M.S.E.E., Purdue, 1953.

WILLIAM HUGH MASON (1947) Assistant Professor of Manufacturing Processes
B.S., Eastern Kentucky State Teachers, 1943; M.S.Ed., Purdue, 1948.

JOHN HORACE MATTHEWS (1926) Associate Professor of Civil Engineering
B.S.C.E., Purdue, 1925; M.S.C.E., 1929 (P.E., Indiana).

WILTON NEWTON MELHORN (1954) Assistant Professor of Geology
B.S., Michigan State, 1942; M.S., 1951.

PHILIP SHERWOOD MENTZ (1953) Instructor in Engineering Drawing
B.S.Ind.Engr., Alabama, 1951.

CHARLES WILLIAM MESSERSMITH (1927) Professor of Experimental Mechanical Engineering
B.S.M.E., Purdue, 1927; M.S.E., 1936 (P.E., Indiana).

LLOYD QUENTON METTES (1951) Assistant, Joint Highway Research Project, Engineering Experiment Station
B.S.C.E., Purdue, 1950; M.S.C.E., 1954.

HAROLD LOUIS MICHAEL (1950) Assistant Director, Joint Highway Research Project, Engineering Experiment Station; Assistant Professor of Highway Engineering
B.S.C.E., Purdue, 1950; M.S.C.E., 1951 (P.E., Indiana).

ROBERT DOUGLAS MILES (1949) Assistant, Joint Highway Research Project, Engineering Experiment Station; Assistant Professor of Highway Engineering
B.S.C.E., Purdue, 1949; M.S.C.E., 1951 (P.E., Indiana).

MELVIN WILLIAM MILGATE (1954) Instructor in Engineering Drawing
B.A., Aurora, 1948; B.S., Southern Illinois, 1951.

WILLIAM TODD MILLER (1926; 1928) Professor of Mechanical Engineering
B.S.M.E., Purdue, 1916 (P.E., Indiana).

ROSCOE E MILLS (1921) Professor of Civil Engineering
B.S.C.E., Purdue, 1920; M.S.C.E., 1928 (P.E., Indiana).

HAROLD AUGUST MONTGOMERY (1946) Instructor in Manufacturing Processes
B.S.T. & I. E., Purdue, 1942; M.S., 1954.

GUY EUGENE MOORE (1954) Instructor in Manufacturing Processes

NANCY YOUNG MOORE (1947-1950; 1951) Assistant in the Engineering Experiment Station
A.B., Indiana, 1938.

RALPH A MORGEN (1954) Professor of Chemical Engineering; Research Director, Purdue Research Foundation
B.S., California, 1923; Ph.D., 1925.

JAMES GRAHAM MORRIS (1951) Instructor in Metallurgical Engineering
B.S.Met.E., Purdue, 1951.

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* Leave of absence, 1954-1955.

FREDERICK BAKER MORSE (1946)...........Assistant Professor of Mechanical Engineering
B.S., Oregon State, 1942; M.S.M.E., Purdue, 1947 (P.E., Indiana).

GEORGE VERNON MUELLER (1925)...................Professor of Electrical Engineering
B.S.M.E., Kansas State, 1924; B.S.E.E., 1925; M.S.E.E., Purdue, 1927 (P.E., Indiana).

GEORGE WESLEY MUNRO (1906)..................Professor Emeritus of Thermodynamics
B.S.E.E., Purdue, 1897; E.E., 1898.

JOHN EARLE MYERS (1950)...................Associate Professor of Chemical Engineering
B.Sc., Alberta (Canada), 1944; M.A.Sc., Toronto (Canada), 1946; Ph.D., Michigan, 1952.

CLYDE RUSSELL NICHOLS (1930-1931; 1947)....Associate Professor of Electrical Engineering
B.S.E.E., Texas A. and M., 1929; M.S.E.E., 1930 (P.E., Indiana).

ROBERT ARNOLD OLSEN (1946).............Assistant Professor of Mechanical Engineering
B.S.M.E., New Hampshire, 1942; M.S.M.E., Purdue, 1947.

HENDRIK JACOB OORTHUYS (1946)...........Assistant Professor of Electrical Engineering
B.S., Oregon State, 1934; M.S., 1936.

JOHN ROBERT OSBORNE (1951)....................Instructor in Mechanical Engineering
B.S.M.E., Purdue, 1950; M.S.M.E., 1953 (E.I.T., Indiana).

HALSEY FRANKLIN OWEN (1938)...................Professor of Manufacturing Processes
B.S., Wisconsin, 1920; M.E., 1939 (P.E., Indiana).

GEORGE MARSHALL PALMER, JR. (1947)...........Instructor in Aeronautical Engineering
B.S.Aero.E., Purdue, 1945; M.S.Aero.E., California Institute of Technology, 1946;
Aero.E., 1947.

NORMAN ALLEN DEVINE PARLEE (1953)...Associate Professor of Metallurgical Engineering
B.Sc., Dalhousie (Canada), 1935; M.Sc., 1937; Ph.D., McGill (Canada), 1939
(P.E., Novia Scotia).

GORDON RADFORD PARTRIDGE (1950)......Associate Professor of Electrical Engineering
B.E., Yale, 1946; M.E., 1947; Ph.D., 1950.

MERLE PARVIS (1946)......Research Engineer, Joint Highway Research Project, Engineering
Experiment Station; Associate Professor of Highway Engineering
B.S.C.E., Purdue, 1927; M.S.C.E., 1946; C.E., 1947 (P.E., Indiana).

ALLEN CHARLES PAULS (1952-1953; 1954)..............Instructor in Chemical Engineering
B.S.Ch.E., Purdue, 1951.

ELMER LOUIS PERTZ (1913).......................Instructor in Manufacturing Processes

BENJAMIN HARRISON PETTY (1920).........Highway Specialist, Joint Highway Research
Project, Engineering Experiment Station; Professor of Highway Engineering
B.S.C.E., Purdue, 1913 (P.E., Indiana).

BLUCHER ADAMS POOLE (1951)..............Professorial Lecturer in Sanitary Engineering
B.S.C.E., Purdue, 1931 (P.E., Indiana).

JOHN HOWARD PORSCH (1928).........................Professor of Engineering Drawing
B.S.C.E., Purdue, 1928; M.S.C.E., 1932 (P.E., Indiana).

ANDREY ABRAHAM POTTER (1920)..........Dean Emeritus of the Schools of Engineering
S.B., Massachusetts Institute of Technology, 1903; D.Eng., Kansas State, 1925; D.Sc., Northeastern, 1936; LL.D., Norwich, 1944; Sc.D., Alfred, 1947; D.Eng., Rose Polytechnic, 1947; D.Eng., South Dakota School of Mines and Metallurgy, 1949 (P.E., Indiana).

CHARLES LAFAYETTE PROCTOR (1953)................Instructor in Engineering Drawing
B.S.M.E., Oklahoma A. and M., 1951 (P.E., Kansas).

BAYARD ELMER QUINN (1946).......................Professor of Mechanical Engineering
B.S.M.E., Drexel, 1937; M.S.Engr., Cornell, 1942; Ph.D., 1945 (P.E., Indiana and Pennsylvania).

ANDREW PETER RADKINS (1949-1950; 1954)...........Instructor in Industrial Engineering
B.S.M.E., Iowa State, 1947; M.S.Ind.E., Purdue, 1950 (P.E., Iowa).

THOMAS BLACKWELL REES (1919)..................Instructor in Manufacturing Processes

BRUCE ALAN REESE (1946)........Assistant Professor of Mechanical Engineering
B.S.M.E., New Mexico, 1944; M.S.M.E., Purdue, 1948; Ph.D., 1953.

DOUGLAS EDWARD REGENBRECHT (1948)........Instructor in Mechanical Engineering; Assistant in the Engineering Experiment Station
B.S., Texas A. and M., 1948; M.S.M.E., Purdue, 1951.

MUAMMER FAIK RENDA (1953)........Instructor in Manufacturing Processes
B.S.M.E., Purdue, 1952.

CHARLES WILLIAM REZEK, JR. (1947)........Instructor in Mechanical Engineering
B.S.M.E., Purdue, 1947; M.S.M.E., 1949.

BOBBIE LEON RICHARDSON (1953; 1954)........Instructor in Engineering Sciences
B.S.E.M., Purdue, 1953; M.S.E.M., 1954 (E.I.T., Indiana).

JUSTUS RISING (1923)........Professor of Engineering Drawing
M.E., Cornell, 1913 (P.E., Indiana).

JOHN ARTHUR RITCHEY (1952)........Assistant Professor of Industrial Engineering
B.S.E.E., Purdue, 1941; M.S., Massachusetts Institute of Technology, 1946.

MARCUS DALE ROBERTS (1942-1943; 1945)........Assistant Professor of Manufacturing Processes
A.B., B.S., Marion, 1927; M.S., Indiana, 1932

DELBERT EARL ROBISON (1950)........Assistant in the Engineering Experiment Station; Instructor in Mechanical Engineering
B.S.M.E., Idaho, 1950; M.S.M.E., Purdue, 1952.

CLARENCE JAMES ROGERS (1946)........Associate Professor of Engineering Drawing
B.S., Bradley Polytechnic, 1934; M.A., Northwestern, 1946.

LEWIS DOW ROWELL (1911)........Professor Emeritus of Electrical Engineering
B.S.E.E., Wisconsin, 1901.

HARRY RUBENKOENIG (1914)........Professor Emeritus of Mechanical Engineering
B.S.M.E., Texas A. and M., 1904; M.E., Purdue, 1917.

JOHN HENRY RUSHTON (1955)........Professor of Chemical Engineering
B.S.Ch.E., Pennsylvania, 1926, M.S., 1929, Ph.D., 1933.

ELIAS MORSHED SABBAGH (1928)........Professor of Electrical Engineering
B.E.E., Ohio State, 1926; M.S., Michigan State, 1928; Ph.D., Purdue, 1934 (P.E., Indiana).

DENVER SAMS (1946)........Assistant Professor of Manufacturing Processes
B.S., Eastern Kentucky State Teachers, 1943; M.S.Ed., Purdue, 1951.

WILLIAM BURTON SANDERS, SR. (1919)........Professor of Engineering Sciences
B.S.M.E., Purdue, 1919; M.S.M.E., 1922 (P.E., Indiana).

WILLIAM OSMOND SATTERLEY (1946)........Assistant Professor of Engineering Drawing
B.S., Stout Institute, 1930; M.A., Michigan, 1939.

ALFRED FREDERICK SCHMITT (1948)........Instructor in Aeronautical Engineering
B.S.Aero.E., Purdue, 1948; M.S.Aero.E., 1949; Ph.D., 1953 (E.I.T., Indiana).

ROBERT LOWRY SCHOENBERGER, JR. (1951)........Instructor in Mechanical Engineering
B.S.M.E., Bradley, 1949; M.S.M.E., Purdue, 1954 (P.E., Indiana and Illinois).

JOHN CLAUDE SCHUDER (1949)........Assistant Professor of Electrical Engineering
B.S.E.E., Illinois, 1943; M.S.E.E., Purdue, 1951; Ph.D., 1954.

REINHARDT SCHUHMANN, JR. (1953)........Professor of Metallurgical Engineering
B.S., Missouri School of Mines, 1933; M.S., Montana School of Mines, 1935;
Sc.D., Massachusetts Institute of Technology, 1938.

MARION BOARDMAN SCOTT (1937-1941; 1942)........Associate Professor of Civil Engineering
B.S.C.E., Nebraska, 1934 (P.E., Indiana).

JOHN PAUL SELLERS, JR. (1950)........Assistant in the Engineering Experiment Station
B.M.E., Ohio State, 1943; M.S.Aero.E., Purdue, 1948.

*HYMAN S SERBIN (1947)........Professor of Aeronautical Engineering
B.S., Carnegie Institute of Technology, 1933; Ph.D., Pittsburgh, 1937.

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* Leave of absence, 1954-1955.

ALEXANDER SESONSKE (1954)..................Associate Professor of Chemical Engineering
B.Ch.E., Rensselaer Polytechnic, 1942; M.S., Rochester, 1947; Ph.D., Delaware, 1950 (P.E., Ohio).

MERRILL EDWARD SHANKS (1946)..................Professor of Aeronautical Engineering
B.A., Iowa, 1932; M.A., Columbia, 1933; Ph.D., Iowa, 1936.

AUSTIN LINN SHELLEY (1950)..........................Instructor in Electrical Engineering
B.S.E.E., Kentucky, 1947; M.S.E.E., Purdue, 1952.

JAMES ROBERT SHEPARD (1949)..............Research Engineer, Joint Highway Research Project, Engineering Experiment Station; Instructor in Highway Engineering
B.S.C.E., Purdue, 1949; M.S.C.E., 1951 (P.E., Indiana).

GEORGE WILLIAM SHERMAN, JR. (1912)..............Professor of Chemical Engineering
B.S.E.E., Rhode Island State, 1912; M.S., Purdue, 1914.

*ALBERT MARCELLUS SHOEMAKER (1947)...........Instructor in Electrical Engineering
B.S.E.E., Purdue, 1932.

RANDOLPH NORRIS SHREVE (1930)...................Professor of Chemical Engineering (Head of the School of Chemical and Metallurgical Engineering, 1947-1951); Director, Formosa-Purdue Engineering Project
A.B., Harvard, 1907 (P.E., Indiana).

WILMER LAWRENCE SIBBITT (1940-1945; 1946)......Professor of Mechanical Engineering
B.S.Ch.E., Purdue, 1937; M.S.E., 1940; Ph.D., 1942 (P.E., Indiana).

LEWIS KETCHAM SILLCOX (1946).......Non-Resident Professorial Lecturer of Engineering
D.Sc., Clarkson, 1932; D.Eng., Cumberland, 1941; LL.D., Syracuse, 1948; D.Eng., Purdue, 1951.

CHARLES SEYMOUR SISKIND (1929)...........Assistant Professor of Electrical Engineering
B.S.E.E., Carnegie Institute of Technology, 1921; M.S.E.E., Purdue, 1932.

ROBERT PEER SISKIND (1938).........................Professor of Electrical Engineering
S.B., Massachusetts Institute of Technology, 1924; S.M., Harvard, 1925 (P.E., Indiana).

THOMAS EDWARD SKORAN (1953)....................Instructor in Engineering Drawing
B.S.M.E., Purdue, 1953.

CLYDE PRESTON SMITH (1950).....................Instructor in Manufacturing Processes
B.S.M.E., Purdue, 1950; M.S.Ind.E., 1954.

JOE MAUK SMITH (1945)......................Professor of Chemical Engineering; Assistant Director of the Engineering Experiment Station
B.S., California Institute of Technology, 1937; Sc.D., Massachusetts Institute of Technology, 1943.

RICHARD DUNHAM SMITH (1951)........Assistant in the Engineering Experiment Station
B.S.M.E., Rutgers, 1951; M.S.M.E., Purdue, 1953 (E.I.T., Indiana).

CLARA BIRCH SNEPP (1954).........................Instructor in Engineering Drawing
B.S.H.E., Purdue, 1954.

JOSEPH WOODY SNYDER (1953)................Assistant, Joint Highway Research Project, Engineering Experiment Station
B.S.C.E., Purdue, 1951 (E.I.T., Indiana).

HARRY LELAND SOLBERG (1921)..........Head of the School of Mechanical Engineering; Professor of Mechanical Engineering; Director of the Mechanical Engineering Laboratories
B.S., South Dakota State, 1920; B.S.M.E., Purdue, 1921; M.S.M.E., 1923 (P.E., Indiana).

PHILLIP ERVIN SONESON (1930)...........Associate Professor of Architectural Engineering
B.S.A.E., Illinois, 1926; M.S.E., Purdue, 1938 (P.E., Indiana).

†RICHARD EDWARD SPAID (1952)..................Instructor in Engineering Drawing
B.S.M.E., Purdue, 1952.

ALBERT RUFF SPALDING (1940)........Head of the Department of Freshmen Engineering; Professor of Mechanical Engineering
B.S.I.E., Lehigh, 1937; M.S.M.E., Purdue, 1942; Ph.D., 1948 (P.E., Indiana).

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* Leave of absence, 1954-55.

† Leave of absence, for military duty, 1954-1955.

GEORGE EVERETT SPENCER (1929) .... Acting Head of the Department of Agricultural Engineering; Professor of Agricultural Engineering
B.S.C.E., Purdue, 1927; M.S.E., 1934 (P.E., Indiana).

PAUL LESLIE SPENCER (1948) .... Assistant Professor of Electrical Engineering
B.S., Illinois, 1931; M.S., 1935.

CARLTON STANLEY SPRAGUE (1925) .... Associate in the Engineering Experiment Station; Associate Professor of Electrical Engineering; Supervisor of the High Voltage Laboratory
B.S.E.E., Worcester Polytechnic, 1923; E.E., 1932; M.S.E., Purdue, 1934; Ph.D., 1943.

GEORGE PERRCY SPRINGER (1927) .... Professor Emeritus of Civil Engineering
B.S.C.E., Michigan State, 1911; C.E., 1921 (P.E., Indiana).

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A.B., Manchester, 1930; M.A., Ohio State, 1933; Ph.D., 1937.

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B.S.Ch.E., Purdue, 1932; B.S.M.E., 1933; M.S.E., 1944 (P.E., Indiana).

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B.S.E.E., M.S.Ind.Engr., M.S.Ind.Psych., Oklahoma A. and M., 1953.

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S.B., Massachusetts Institute of Technology, 1946; S.M., 1952.

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B.S.C.E., Colorado, 1921; C.E., 1926; M.S.C.E., Illinois, 1932 (P.E., Indiana and Rhode Island).

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B.S.M.E., Lehigh, 1949.

RAYMOND HAROLD TAYLOR (1952) .... Instructor in Manufacturing Processes

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B.S.C.E., Purdue, 1938; M.S.E., 1941 (P.E., Indiana).

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B.S.C.E., Purdue, 1923; M.S.Ind.Eng., 1949 (P.E., Indiana).

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JOHN WILLIAM TIERNEY (1954) .... Assistant Professor of Chemical Engineering
B.S.Ch.E., Purdue, 1947; M.S., Michigan, 1948; Ph.D., Northwestern, 1951 (E.I.T., Indiana).

ALANSON NILES TOPPING (1903) .... Professor Emeritus of Electrical Engineering
B.S.E.E., Kansas, 1894.

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M.S.C.E., Purdue, 1951.

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B.M.E., Louisville, 1953.

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B.S.C.E., Michigan, 1906 (P.E., Indiana).

HARVEY ROBERT WILKE (1949) .... Associate Professor of Sanitary Engineering
B.S.C.E., Missouri, 1939; M.S.C.E., 1940 (P.E., Indiana).

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B.S.M.E., Purdue, 1951; M.S.Ind.Eng., 1952.

OTTO WILLIAM WITZELL (1946) .... Associate Professor of Mechanical Engineering
B.E., Johns Hopkins, 1937; M.S.M.E., Purdue, 1949; Ph.D., 1951.

ROBERT NELSON WOERNER (1946) .... Accountant, Engineering Experiment Station
B.S.E.E., Purdue, 1946.

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B.S., Case, 1948; M.S.M.E., Purdue, 1950.

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B.C.E., Ohio State, 1932; C.E., 1937 (P.E., Indiana).

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B.A., Oberlin, 1916; B.Sc.Eng., Minnesota, 1920; C.E., 1938 (P.E., Illinois).

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ELDON JOSEPH YODER (1945-1947; 1949)........................Research Engineer, Joint Highway Research Project, Engineering Experiment Station; Associate Professor of Highway Engineering
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B.S.M.E., Harvard, 1922; M.S.M.E., 1923; Ph.D., Purdue, 1928.

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